Attachments

A. Emissions Inventories
B. Emission Reduction Calculations
C. Biographical Sketch(s)
D. Negotiated Indirect Cost Rate Agreement
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A. Emissions Inventories

FAIRBANKS $PM_{2.5}$ NONATTAINMENT AREA EMISSIONS INVENTORY

1. Overview

This appendix to the TAS Grant Application documents the emissions inventory for directly-emitted $PM_{2.5}$ and precursor pollutants (SO_2, NOx, VOC and NH_3) in the Fairbanks $PM_{2.5}$ nonattainment area. This emissions inventory (EI) is the 2019 "Control" inventory documented in the Serious Area $PM_{2.5}$ State Implementation Plan (SIP) submitted by the Alaska Department of Environmental Conservation (ADEC) to the U.S. Environmental Protection Agency (EPA) in December 2019.[1] This 2019 Control inventory represents the most emissions and source activity and includes emission reductions accrued through the end of 2018 associated with on-going control programs adopted and implemented under the EPA-approved Moderate Area SIP. These include the Borough's Wood Stove Change Out (WSCO) Program and the Solid Fuel Burning Curtailment Program (now operated by ADEC).

The 2019 emissions inventory is a seasonal, rather than annual inventory and represents average episodic day emissions based on the historical modeling episode days employed in the Serious SIP:

- Episode 1 – January 23 through February 10, 2008 (19 days)
- Episode 2 – November 2 through November 17, 2008 (16 days)

Use of a seasonal rather than an annual inventory for attainment analysis within the SIP was based on guidance contained in EPA's 2016 PM Implementation Rule.[2] The rationale is that $PM_{2.5}$ and precursor emissions vary significantly over a year. During the winter nonattainment season, daily emissions are higher than over the remainder of the year due to increases in space heating and electricity demand under cold Arctic conditions with fewer daylight hours. All historical violations of the 24-hour $PM_{2.5}$ National Ambient Air Quality Standards (NAQQS) in Fairbanks have occurred during this winter nonattainment season (October through March). Table 1 presents a summary of emissions by source sector within the nonattainment area from the 2019 Control inventory. Emissions are given in units of tons/day, averaged over the modeling episode days listed above.

Table 1
2019 Control Episode Average Daily Emissions (tons/day) by Source Sector

Source Sector	$PM_{2.5}$	NOx	SO_2	VOC	NH_3
Point	0.83	10.63	7.13	0.09	0.020
Area, Space Heat, All	2.11	2.44	3.87	8.62	0.132
Area, Space Heat, Wood	1.95	0.40	0.14	8.40	0.086
Area, Space Heat, Oil	0.07	1.83	3.61	0.10	0.004
Area, Space Heat, Coal	0.08	0.05	0.09	0.11	0.014
Area, Space Heat, Other	0.01	0.17	0.02	0.01	0.029
Area, Other	0.20	0.25	0.02	2.35	0.049
On-Road Mobile	0.14	1.83	0.01	2.86	0.038
Non-Road Mobile	0.24	1.21	10.62	0.41	0.000
TOTALS	**3.53**	**16.36**	**21.64**	**14.33**	**0.238**

[1] https://dec.alaska.gov/air/anpms/communities/fbks-pm2-5-serious-sip/
[2] Federal Register, Vol. 81, No. 164, August 24, 2016 (81 FR 58010).

Within Table 1, Point sources refer to major[3] stationary sources (e.g., power plants and other industrial facilities) that are modeled as individual "point" sources. Area sources (also referred to as stationary non-point sources) represent all other stationary emission sources that are not major source individually are too large in number to model as individual sources. As shown in Table 1 (and broken out further by fuel type) space heating (from both residential and commercial source) is the largest source sector for directly-emitted $PM_{2.5}$; direct $PM_{2.5}$ from all other area sources (Area, Other) is one-tenth that of space heating. The mobile source portion of the inventory is divided into on-road and non-road sectors. The former encompasses all on-road vehicles (passenger cars, light- and heavy-duty trucks, buses and motorcycles while the latter represents all non-road vehicles equipment (such as construction equipment, industrial equipment, lawn and garden equipment, recreational equipment and vessels) and also includes aircraft and locomotive emissions. For all applicable pollutants except SO_2, on-road and non-road mobile sources are relatively minor contributors to total emissions within the nonattainment area. SO_2 emissions are directly related to the sulfur content of the fuel used within each source sector. And although not shown in the summarized inventory, aircraft emissions make up over 99% of the 10.62 tons/day total for non-road sources in Table 1. (For all other mobile sources fuel sulfur levels are in the 30 ppm or less range. For aircraft, jet fuel sulfur content is much higher: 900 ppm).

Relative contributions by source sector to total emissions within the nonattainment area for each pollutant are provided below in Table 2. As shown and noted above, space heating, especially with wood, is the largest contributor to $PM_{2.5}$, comprising nearly 60% of total directly-emitted $PM_{2.5}$ across the nonattainment area. Space heating is also the majority contributor for VOC and NH_3. For NOx, point sources are the single largest contributor, representing 65% of total emissions. Finally, SO2 emissions largely occur from three source categories: 1) point sources (largely from distillate oil rather than coal combustion); 2) heating oil within the space heating sector; and 3) aircraft jet fuel within the non-road sector as discussed above.

Table 2
2019 Control Episode Average Daily Emissions (tons/day) by Source Sector

Source Sector	$PM_{2.5}$	NOx	SO_2	VOC	NH_3
Point	23.6%	65.0%	32.9%	0.6%	8.3%
Area, Space Heat, All	59.6%	14.9%	17.9%	60.2%	55.5%
Area, Space Heat, Wood	55.2%	2.4%	0.7%	58.6%	36.1%
Area, Space Heat, Oil	1.9%	11.2%	16.7%	0.7%	1.5%
Area, Space Heat, Coal	2.2%	0.3%	0.4%	0.8%	5.8%
Area, Space Heat, Other	0.4%	1.0%	0.1%	0.1%	12.1%
Area, Other	5.8%	1.5%	0.1%	16.4%	20.4%
On-Road Mobile	4.1%	11.2%	0.0%	20.0%	15.8%
Non-Road Mobile	6.9%	7.4%	49.1%	2.9%	0.0%
TOTALS	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

[3] Major stationary sources as defined here and in the SIP use the definition of a major source under Title V of the Clean Air Act (as specified in 40 CFR §51.20) to define the "major source" thresholds for reporting annual emissions. These thresholds generally are the potential to emit (PTE) annual emissions of 100 tons for all relevant criteria air pollutants, but for Serious Area SIP inventories include sources above 70 tons/year.

All the SIP inventories including the 2019 Control inventory were developed in a manner consistent with the EI requirements for Serious area Plans specified in EPA's PM Rule. This included development of a foundational or historical baseline inventory of all sources/activity for calendar year 2013. Once the 2013 Baseline inventory was developed, inventories in later calendar years such as the current 2019 Control inventory were determined by projecting source activity changes and emission control effects for programs/measure phased in or implemented between 2013 and that later year. As noted above, the 2019 Control inventory includes calculated emission reductions from state and local programs such as the WSCO and Curtailment programs as well as federal control programs such as mobile source vehicle and fuel emission standards. As a result, documentation of the 2019 Control inventory begins with a discussion of the data sources, methods and assumptions used to develop the foundational 2013 Baseline inventory, followed by descriptions of the sources and approach used to project these emissions to 2019 and account for effects of emissions control measures (relative to 2013).

2. 2013 Baseline Inventory

For all inventory sectors, 2013 Baseline emissions were calculated using a "bottom-up" approach that relied heavily on an exhaustive set of locally-measured data used to support the emission estimates. For source types judged to be less significant or for which local data were not available, estimates relied on EPA-developed NEI county-level activity data and emission factors from EPA's *Compilation of Air Pollutant Emission Factors* AP-42 database.[4]

Table 3 briefly summarizes the data sources and methods used to develop episodic modeling inventory emissions by source type. It also highlights those elements based on locally collected data. As shown by the shaded regions in Table 3, the majority of both episodic wintertime activity and emission factor data supporting the 2013 Baseline inventory was developed based on local data and test measurements.

As evidenced by source classification structure used to highlight utilization of key local data sources, development of detailed episodic emission estimates to support the attainment modeling focused on three key source types:

1. *Stationary Point Sources* – industrial facility emissions for "major" stationary sources as defined earlier developed from wintertime activity and fuel usage;

2. *Space Heating Area (Nonpoint) Sources* – residential and commercial heating of buildings with devices/fuels used under wintertime episodic ambient conditions; and

3. *On-Road Mobile Sources* – on-road vehicle emissions based on local activity and fleet characteristics with EPA-accepted adjustments to account for effects of wintertime engine block heater "plug-in" use in Fairbanks using MOVES2014b (the latest version of MOVES) coupled with local activity and fuel data for key non-road sources such as aircraft, rail and snowmobiles.

[4] Compilation of Air Pollutant Emission Factors," Fifth Edition and Supplements, AP-42, U.S. EPA, Research Triangle Park, NC. January 1995.

Table 3
Summary of Data/Methods Used in the Serious SIP 2013 Baseline Inventory

Source Type/Category	Source Activity	Emission Factors
Point Sources	Episodic facility and stack-level fuel use and process throughput	Continuous emissions monitoring or facility/fuel-specific factors
Area (Nonpoint) Sources, Space Heating	Detailed wintertime FNSB nonattainment area residential heating device activity measurements and surveys	- Test measurements of common FNSB wood and oil heating devices using local fuels - AP-42 factors for local devices or fuels not tested (natural gas, coal)
Area Sources, All Others	- Seasonal, source category-specific activity from a combination of State/Borough sources - NEI-based activity for commercial cooking	AP-42 emission factors
On-Road Mobile Sources	Local estimates of seasonal vehicle miles traveled	- MOVES2014b emission factors based on local fleet/fuel characteristics - Augmented with FNSB wintertime vehicle warmup and plug-in emission testing data
Non-Road Mobile Sources	- Local activity estimates for key categories such as snowmobiles, aircraft and rail - MOVES2014b model-based activity for FNSB for other categories	- MOVES2014b model factors for non-road equipment - AEDT model factors for aircraft - EPA factors for locomotives

Following this overview, separate sub-sections describe the approaches used to generate episodic emission estimates for each of the source types/categories listed in Table 3 for the 2013 Baseline inventory. The final sub-section presents detailed tabulations of the 2013 Baseline inventory.

Stationary Point Sources

For the 2013 Baseline modeling inventory, facilities from ADEC's Title V permits database were to identify major and minor point source facilities within the modeling domain. As noted earlier, ADEC uses the definition of a major source under Title V of the Clean Air Act (as specified in 40 CFR §51.20) to define the "major source" thresholds for reporting annual emissions. These thresholds are the potential to emit (PTE) annual emissions of 100 tons for all relevant criteria air pollutants. Natural minor and synthetic minor facilities (between 5 and 99 TPY) reporting emissions under either New Source Review (NSR) or Prevention of Significant Deterioration (PSD) requirements were also included in the query to identify facilities down to the 70 tons/year threshold required to classify stationary point sources under Serious Area inventory requirements.

A total of 14 facilities were identified. Of these, DEC noted that three of the facilities—the Golden Valley Electric Association (GVEA) Healy Power Plant and the heating/power plants at Fort Greely (near Delta Junction) and Clear Air Force Base (near Anderson)—were excluded from development of episodic emissions. These facilities were excluded because of their remoteness relative to Fairbanks (all are between 55 and 78 miles away)[5] or the fact that they were located generally downwind of the nonattainment area under episodic air flow patterns (Healy Power Plant and Clear AFB). Three others were identified as minor/synthetic minor sources: (1) Fort Knox Mine (26 miles northeast of Fairbanks), (2) Usibelli Coal Preparation Plant (in Healy), and (3) CMI Asphalt Plant (in Fairbanks); these were excluded from treatment as individual stationary point sources because they either were located outside the nonattainment area (Fort Knox and Usibelli) or exhibited insignificant wintertime activity (CMI Asphalt Plant). These facilities excluded from the point source sector were treated as stationary non-point or area sources within the inventory.

The names and primary equipment and fuels of the eight remaining facilities for which episodic data were collected and developed are summarized in Table 4. One facility, Eielson Air Force Base, is located just outside the nonattainment area boundary on the southeast edge. All other facilities listed in Table 4 are located within the nonattainment area.

Table 4
Summary of SIP Modeling Inventory Point Source Facilities

Fac. ID	Facility Name	Primary Equipment/Fuels
71	Flint Hills North Pole Refinery	11 crude & process heaters burning process gas/LPG (9 operated during episodes), plus 2 natural gas fired steam generators, gas flare
109	GVEA Zehnder (Illinois St) Power Plant	Two gas turbines burning HAGO[a], two diesel generators burning Jet A
110	GVEA North Pole Power Plant	Three gas turbines, two burning HAGO, one burning naphtha (plus an emergency generator and building heaters not used during episodes)
236	Fort Wainwright	Backup diesel boilers & generators (3 each) - none operated during episodes
264	Eielson Air Force Base	Over 70 combustion units - six coal-fired main boilers only operated during episodes
315	Aurora Energy Chena Power Plant	Four coal-fired boilers (1 large, 3 small), all exhausted through common stack
316	UAF Campus Power Plant	Two coal-fired, two oil-fired boilers (plus backup generators & incinerator not operated during episodes)
1121	Doyon Utilities (private Fort Wainwright units)	Six coal-fired boilers

[a] Heavy Atmospheric Gas Oil. HAGO is a crude distillate at the heavy end of typical refinery “cuts” with typical boiling points ranging from 610-800°F. Due to geographic proximity, GVEA seasonally used HAGO, a by-product from the adjacent Flint Hills Refinery until the refinery was shut down in 2014.

[5] Individual point source plume modeling conducted by DEC in support of the SIP using the CALPUFF model found that under the episodic meteorological conditions, emissions from facilities located outside the Fairbanks $PM_{2.5}$ nonattainment area exhibited negligible contributions to ambient $PM_{2.5}$ concentrations in the area.

ADEC then requested additional actual day- and hour-specific activity and emissions data from each facility (as available) covering the two 2008 historical modeling episodes. Information was requested for both combustion and fugitive sources. Requested data elements included emission units, stack parameters (height, diameter, exit temperature and velocity/flowrate), release points (location coordinates), control devices (as applicable), seasonal and diurnal fuel properties, and throughput.

The submitted data were then assembled and reviewed for completeness, consistency, and validity prior to integrating the episodic data into the SIP inventories. Given the differences in structure and content of the submitted episodic data, the data were individually reviewed for each facility before being assembled into a consistent inventory structure.

At a minimum, facilities provided SCC codes and hourly $PM_{2.5}$ and SO_2 emission rates by individual emission unit along with daily/hourly fuel usage or process throughput data and emission factors for the remaining criteria pollutants. For facilities that did not provide emissions for all criteria pollutants, NOx, NH_3 and VOC emissions were computed from AP-42-based or facility source test emission factors (where fuel use data were explicitly provided) or from fuel-specific emission factor ratios.

Annual actual emissions by emission unit for each facility in calendar years 2008 and 2013 obtained from DEC permit database (including facility operating reports and permit fee assessments) were then used to scale the day/hour specific 2008 episodic data provided by each facility from 2008 to 2013. This approach essentially simulates the levels of facility-specific emissions from the 2008 modeling episodes relative to annual emissions, carried forward to 2013.[6]

Table 5 compares annual fuel use by facility between 2008 and 2013, including splits of HAGO vs. lighter distillates (distillate #2/#1, Jet A, Naphtha) at the GVEA facilities. As seen, there were generally modest changes (roughly within 10%) in annual throughput/fuel use between 2008 and 2013 for most facilities. The GVEA facilities were the biggest exception, using much less HAGO fuel in 2013 than in 2008 (although HAGO use increased at the Zehnder facility). This is important since HAGO has significantly higher $PM_{2.5}$ and SO_2 emissions per unit of fuel energy than the lighter distillate/Jet A/Naphtha fuels it also uses. Coal use at Doyon was 17% higher in 2013 than 2008.

Generally, each facility provided hourly $PM_{2.5}$ and SO_2 emission rates by individual emission unit. As explained in greater detail below, estimates of NO_x, VOC and NH_3 emission rates were developed from AP-42 based emission factors[7] (where fuel use data were explicitly provided) or from fuel-specific emission factor ratios.

[6] Since day-specific 2013 modeling episodes for the Serious SI baseline year were not developed, there was no reason to obtain day- and hour-specific emissions or fuel use from facility operations in 2013.
[7] AP-42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources," Environmental Protection Agency, January 1995.

Table 5
Comparison of 2013 vs. 2008 Annual Fuel Use by Facility and Fuel Type

Facility ID	Facility Name	Calendar Year	HAGO	Light Distillate	Coal
			(1000 gal/year)		(tons/year)
109	GVEA Zehnder	2008	827	8	n/a
		2013	1,200	1	n/a
		% Change	+45%	-87%	n/a
110	GVEA North Pole	2008	5,634	23,054	n/a
		2013	2,764	23,345	n/a
		% Change	-51%	+1%	n/a
315	Aurora Energy	2008	n/a	n/a	222,592
		2013	n/a	n/a	214,961
		% Change	n/a	n/a	-3%
316	UA Fairbanks	2008	n/a	935	73,900
		2013	n/a	848	68,599
		% Change	n/a	-9%	-7%
1121	Doyon (Fort Wainwright)	2008	n/a	n/a	246,250
		2013	n/a	n/a	288,702
		% Change	n/a	n/a	+17%

Note: Fuel data in both years for Flint Hills Refinery and Eielson AFB were not available, only annual emissions.

Figure 1 through Figure 5 provide comparisons of $PM_{2.5}$, SO_2, NO_x, VOC and NH_3 emissions (for facilities reporting NH_3 emissions), respectively, for each source facility for which episodic data were collected. Within each figure, three sets of daily average emissions (in tons/day) are plotted for each facility, as described below.

1. *2013 E1 Avg* – Episode 1 average daily emissions, scaled forward to 2013
2. *2013 E2 Avg* – Episode 2 average daily emissions, scaled forward to 2013
3. *2013 Annual* – 2013 annual average daily actual emissions (from ADEC database)

All five pollutant plots show two elements very clearly. First, the strong seasonal nature of emissions at many of the facilities is evidenced where episodic daily emissions are higher than annual average daily emissions. For example, as shown in Figure 1 direct $PM_{2.5}$ emissions during the wintertime modeling episodes are much higher than the daily average over the entire year at both GVEA power plants and the Doyon facilities on the Fort Wainwright Army Base. This relates to the fact that more energy is needed for electric heat and power from these facilities during winter when temperatures are colder and nights are longer. Second, each plot shows which facilities are the major point source contributors for each pollutant.

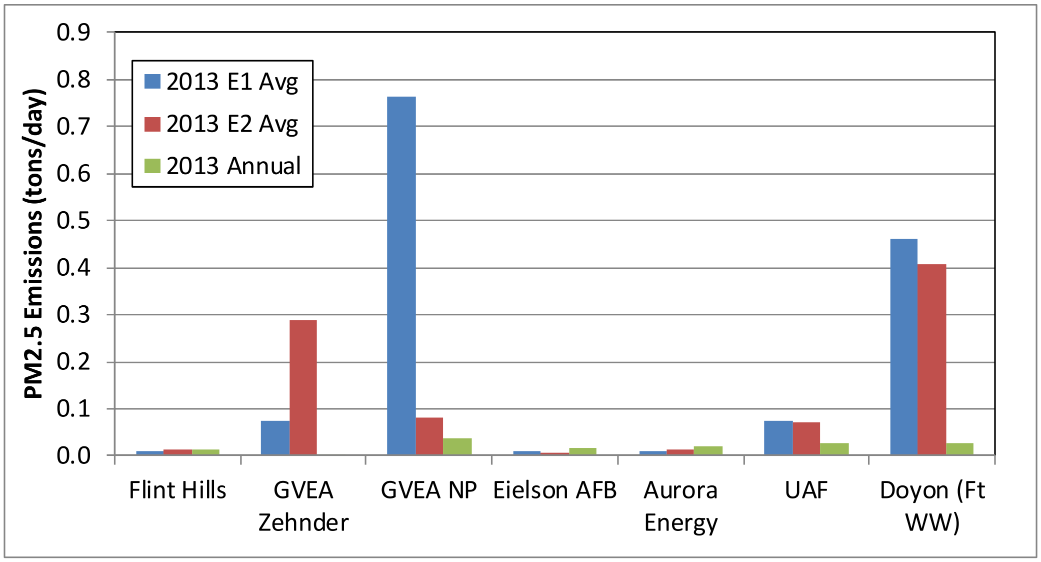


Figure 1. 2013 $PM_{2.5}$ Episodic vs. Annual Average Point Source Emissions (tons/day)

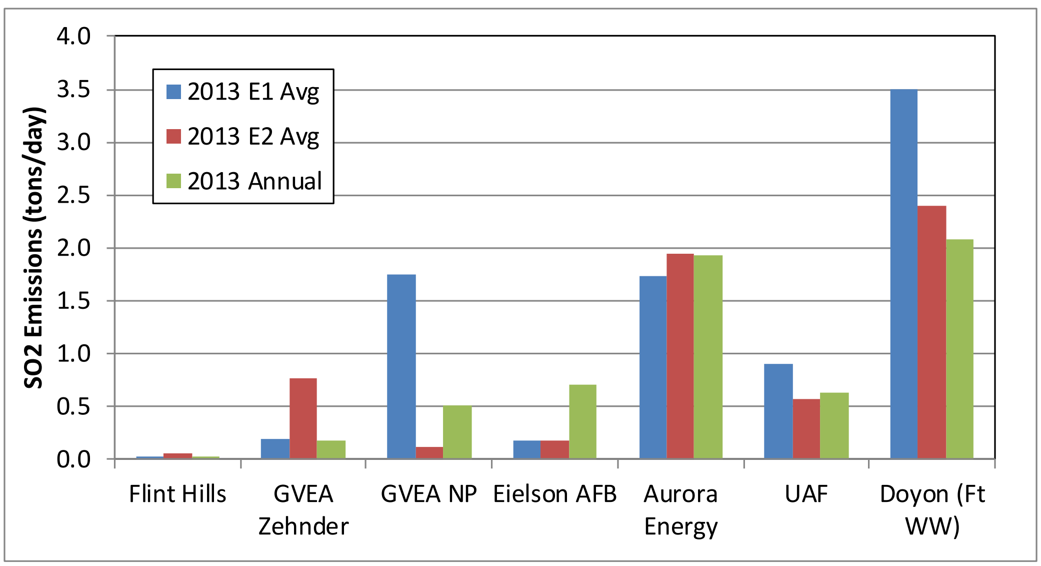


Figure 2. 2013 SO_2 Episodic vs. Annual Average Point Source Emissions (tons/day)

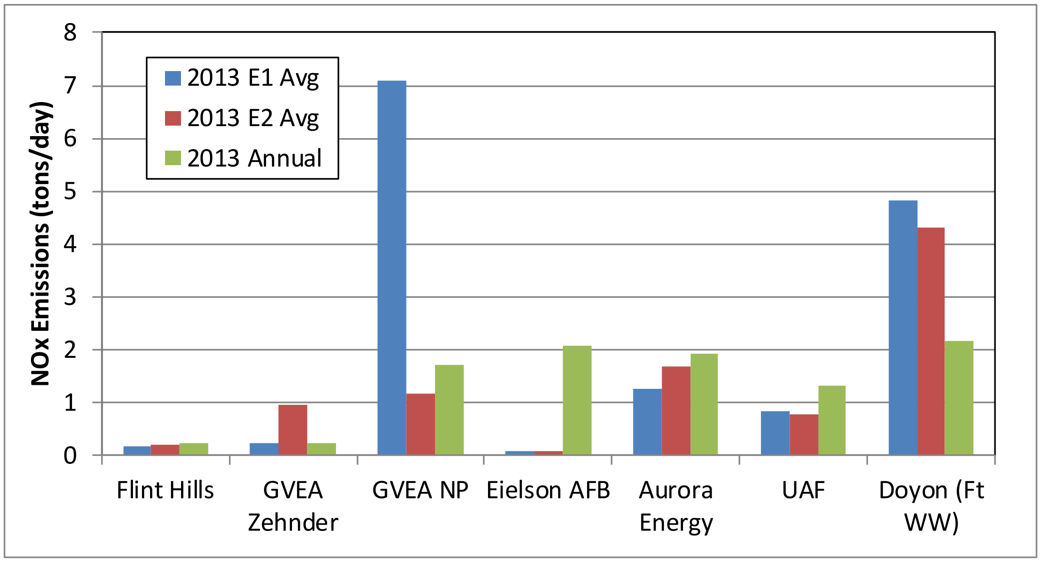


Figure 3. 2013 NO_x Episodic vs. Annual Average Point Source Emissions (tons/day)

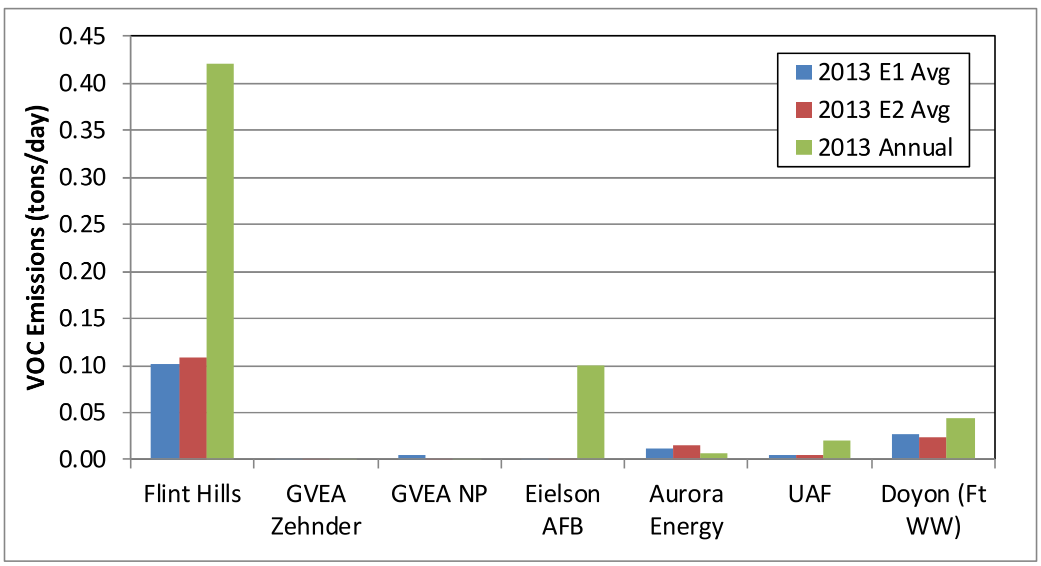
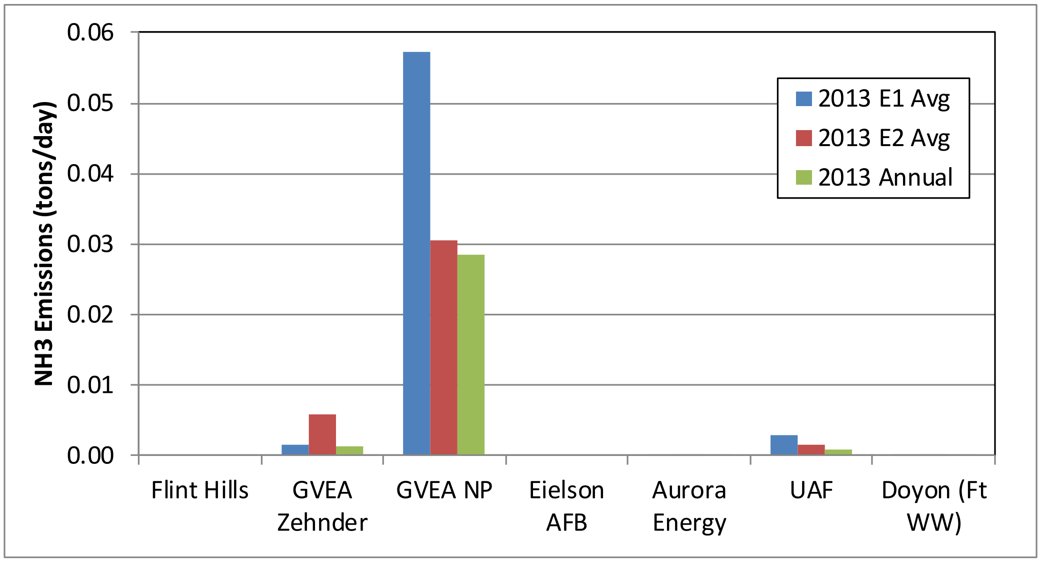


Figure 4. 2013 VOC Episodic vs. Annual Average Point Source Emissions (tons/day)



Note: NH_3 emissions were not reported from Flint Hills and Eielson AFB. Those for Aurora Energy and Doyon are too small to see on the scale of the plot.

Figure 5. 2013 NH_3 Episodic vs. Annual Average Point Source Emissions (tons/day)

Though not shown in Figure 1 through Figure 5, a cross-check of the 2008 to 2013 facility emissions scaling updates was performed to verify that scaled 2013 emissions did not exceed annual PTE limits for each facility.

In the modeling inventory, the episodic actual emissions for each point are represented on a day- and hour-specific basis. The E1 and E2 emission levels shown in the plots are averages compiled from the day- and hour-specific emissions across each modeling episode.

Space Heating Area Sources

Inventory assessments and source apportionment analysis performed to support initial development of the SIP identified space heating as the single largest source category of directly emitted $PM_{2.5}$. Thus, the 2013 Baseline modeling inventory incorporated an exhaustive set of locally collected data in the FNSB that were used to estimate episodic wintertime space heating emissions by heating device type and fuel type. These local wintertime data and their use in generating space heating emissions are summarized below.

- *Fairbanks Winter Home Heating Energy Model* – A multivariate predictive model of household space heating energy use was developed based on highly resolved (down to five-minute intervals) actual instrumented measurements of heating device use in a sample of FNSB homes during winter 2011 collected by the Cold Climate Housing Research Center (CCHRC) in Fairbanks. The energy model was calibrated based on the CCHRC measurements and predicted energy use by day and hour as a function of household size (sq ft), heating devices present (fireplaces, wood stoves, outdoor hydronic heaters, and oil heating devices) and day type (weekday/weekend).

- *Multiple Residential Heating Surveys* – Representations of area (ZIP code) specific wintertime heating device uses and practices were developed from a series of annual telephone-based surveys of residential households within the nonattainment area, ranging in size from 300-700 households per survey. DEC conducted 300-household surveys in 2006, 2007 and 2010 and more robust 700-houshold surveys in 2011, 2012, 2013, 2014 and 2015 that also proportionately sampled cell phone-only households.[8] The 2011-2015 data, which encompassed a combined sample of over 3,500 households was used to develop space heating emissions for this Serious SIP 2013 baseline inventory. These combined 2011-2015 survey results were used to develop estimates of the types and number of heating devices used during winter by 4 km square areas[9] within the nonattainment area. The survey data were also used to cross-check the energy model-based fuel use predictions as well as to identify and apportion wood use within key subgroups (certified vs. non-certified devices and purchased vs. user-cut wood, the latter of which reflects differences in moisture content that affects emissions). Special purpose surveys were also conducted that included a 2013 "Wood Tag" survey of wood-burning households that collected further detail on EPA-certified devices and a 2016 Postcard survey that sought to assess changes in wood use related to heating oil price decreases.
- *Fairbanks Wood Species Energy Content and Moisture Measurements* – CCHRC performed an additional study that measured wood drying practices and moisture content of commonly used wood species for space heating in the FNSB area. These measurements were combined with published wood species-specific energy content data and additional residential survey data (2013 Wood Tag Survey) under which respondents identified the types of wood they used to heat their homes. Birch, Spruce, and "Aspen" (i.e., Poplar) were identified as the three primary locally used wood species.
- *Laboratory-Measured Emission Factors for Fairbanks Heating Devices* – An accredited testing laboratory, OMNI-Test Laboratory (OMNI), was contracted to perform a series of heating device emission tests using a sample of wood-burning and oil heating devices commonly used in the FNSB area in conjunction with samples of locally collected wood and heating oil. The primary purpose of this testing was to evaluate and, if necessary, update AP-42-based emission factors that were generally based on heating device technology circa 1990. The OMNI study provided a comprehensive, systematic attempt to quantify Fairbanks-specific, current technology-based emission factors from space heating appliances and fuels. The laboratory-based emission testing study consisted of 35 tests of nine space heating appliances, using six typical FNSB area fuels. Both direct PM and gaseous precursors (SO_2, NO_x, NH_3) were measured, along with PM elemental profiles. All emission tests were conducted at OMNI's laboratory in Portland, Oregon. Supporting solid fuel, liquid fuel, and bottom ash analyses were performed by Twin Ports Testing, Southwest Research Institute (SwRI), and Columbia Analytical Services, respectively.

[8] Households with only with cell phones and no landline phone. Cell-only households had not been explicitly sampled in the 2010 and earlier surveys.
[9] Modeling grid cells were 1.33 km square. Device and fuel usage distributions from the 2011-2015 survey data were calculated by 4 km square areas (which consist of 3 × 3 sets of modeling grid cells) in order to achieve a minimum statistically sufficient sample size of a least 50 households per 4 km square area across the majority of the nonattainment area.

PM profiles of deposits on Teflon filters from dilution tunnel sampling were analyzed by Research Triangle Institute using XRF, ion chromatography, and thermal/optical analysis.

Residential Space Heating Device Activity - As noted above, device and fuel usage rates were based on the combined 3,500+ households from the 2011-2015 Fairbanks Home Heating (HH) surveys to represent wintertime, episodic space heating activity in the 2013 baseline year, which is centered within the five-year survey data period. Table 6 provides a summary of key results from the HH surveys by individual survey year, and for the combined 2011-2015 survey period, averaged over the nonattainment area.

Below the sample sizes of each survey, winter season (Oct-Mar) device/fuel usage fractions are presented and show the breakdown of heating energy use by fuel type (with detailed breakdown for wood-burning devices). As shown in Table 6, roughly 75% of winter season heating energy is from heating oil (Central Oil, Portable Heater and Direct Vent devices). Wood heating make up roughly 22% of winter heating energy use, and notably rose from 19.2% in 2011 to 24.1% in 2014. This coincides with a period when heating oil prices in Fairbanks hovered near $4 per gallon, and as discussed later in Section 7.6.3, appears to have encouraged residents to burn more wood (a cheaper fuel) when heating oil costs were high.

Table 6
Key Results from 2011-2015 Fairbanks Home Heating Surveys

Metric	Fuel/Device Type	Survey Year					2011-2015
		2011	2012	2013	2014	2015	Combined
Sample Size (households)		712	700	701	700	701	3,514
Winter Season Heating Energy Use Fractions	All Wood	19.2%	22.1%	21.4%	24.1%	20.3%	21.8%
	Fireplace	0.5%	0.8%	0.8%	0.7%	0.3%	0.7%
	Insert, Cordwood	1.0%	0.7%	0.8%	1.0%	0.9%	0.9%
	Stove, Cordwood	13.4%	17.6%	15.7%	18.8%	16.4%	16.6%
	Insert, Pellet	0.8%	0.6%	1.6%	1.8%	0.8%	1.1%
	Stove, Pellet	0.6%	0.6%	1.6%	1.6%	0.8%	1.1%
	Outdoor Wood Boiler	2.9%	1.9%	0.9%	0.2%	1.0%	1.5%
	Central Oil	70.9%	65.9%	73.4%	66.9%	74.5%	70.7%
	Portable/Kerosene Heat	0.9%	0.1%	0.8%	0.4%	0.4%	0.5%
	Direct Vent	4.4%	2.8%	2.4%	3.5%	2.9%	3.3%
	Natural Gas	2.3%	2.3%	1.0%	2.0%	0.5%	1.7%
	Coal Heat	0.3%	0.2%	0.6%	2.1%	0.4%	0.7%
	District Heat	2.0%	1.4%	0.4%	1.0%	1.0%	1.2%
Stove/Insert Cert. Type	Uncertified (<1988)	25.7%	22.7%	20.1%	14.4%	13.9%	19.1%
	Certified (≥1988)	74.3%	77.3%	79.9%	85.6%	86.1%	80.9%
Stove/Insert Tech. Type	Catalytic	39.3%	37.6%	45.6%	44.7%	42.4%	42.0%
	Non-Catalytic	60.7%	62.4%	54.4%	55.3%	57.6%	58.0%
Wood Source	Buy	27.0%	36.1%	35.4%	32.3%	37.4%	33.8%
	Cut Own Wood	61.9%	49.1%	47.1%	54.3%	47.9%	51.8%
	Both (Buy & Cut Own)	11.0%	14.8%	17.5%	13.4%	14.7%	14.4%

Table 6 also presents usage splits for other key survey elements. First, uncertified vs. EPA-certified wood stove or insert fractions (based on the age of the device) are shown to steadily drop from 25.7% in 2011 to 13.9% in 2015. The HH survey asked respondents if their wood stoves or inserts were purchased/installed before or after 1988, the year of EPA's initial New Source Performance Standards (NSPS) that established certification standards for new wood-burning devices.[10] This downward trend in uncertified devices make sense as older devices are retired and new certified wood stoves/inserts are purchased, either under or outside the Borough's WSCO Program. (Though not reflected in Table 6, the uncertified vs. EPA-certified device fractions from the HH surveys are adjusted to reflect the fact that some devices sold after 1988 are not certified as described in Appendix III.D.7.6.) Second, the distribution of EPA-certified devices by technology type (catalytic vs. non-catalytic) is also shown in Table 6 for each survey year and indicates that most existing EPA-certified devices are non-catalytic, the fraction of catalytic technology generally increased over the 2011-2015 survey period. Finally, fractions of the sources of wood are listed at the bottom of Table 6, showing that most wood is cut by respondents, rather than commercially purchased. This wood source distribution is important because "Cut Own" wood tends to have lower moisture content than commercially-purchased wood since it is generally seasoned longer before being burned.

As stated earlier in this sub-section, the combined 2011-2015 HH survey sample was used to represent residential space heating device and fuel use for the 2013 Baseline inventory, as opposed to the 2013 survey data. The rationale behind this decision was twofold:

1. Calendar year 2013 was centered within the 2011-2015 survey period, and any trends over the period (e.g., wood use, uncertified device fractions would be reasonably represented by the combined average over the period); and
2. Use of the combined data provided a roughly five-fold increase in sample size, which as explained in further detail in Appendix III.D.7.6 provided much higher statistical confidence in the usage fractions listed in Table 6, especially for smaller proportion device/fuel combinations such as Outdoor Wood Boilers.

Although the residential space heating energy use data presented earlier in Table 6 were listed as winter season usage percentages, the combined 2011-2015 HH survey data were integrated with the Fairbanks Winter Home Heating Energy Model to develop grid cell-specific estimates of day- and hour-specific heating energy use (in BTUs) for each modeling episode day. A parcel database obtained from the Borough containing building sizes within each residential, commercial, industrial and other (e.g., government) parcel was used within the framework of the Energy Model to determine the amounts of heated building space allocated within each grid cell. These calculations also incorporated the effects of wood moisture, accounting for the fact that wetter wood provides less "effective heating energy" than drier wood. The combined wood moisture content calculated for the 2013 Baseline inventory (weighting Buy and Cut Own wood use at different moisture levels) was 36.5%.

Finally, though not shown earlier in Table 6, data from the combined 2011-2015 HH surveys were tabulated to determine the usage fractions of #1 and #2 distillate heating oil in residential space heating. (One of the survey questions asked of oil-burning households was to estimate their usage of #1 and #2

[10] The question was intentionally designed this way to avoid potential inaccuracies arising if respondents were not certain their device was certified, or could not easily see/identify a certification label on the wood device.

in gallons.) From these responses, residential heating oil usage was estimated to be 68.2% #2 and 31.8% #1 heating oil.

Commercial Space Heating Activity – Space heating activity and emissions associated with fuel combustion in non-residential buildings were determined separately from residential space heating. (Hereafter, the term "commercial" space heating refers to that from all non-residential buildings including commercial, industrial and all other non-residential buildings.)

The Borough parcel/building size database was used to identify the amount of non-residential building space located within each modeling grid cell. Tabulated non-residential building space was combined with an Alaska commercial building heating energy demand factor developed by CCHRC and daily Heating Degree Day (HDD) data for the historical modeling episodes to estimate commercial space heating energy demand.[11]

Under the preceding EPA-approved Moderate Area SIP, commercial space heating energy usage was estimated to be 98% from heating oil and 2% from natural gas. This estimate was reviewed under the Serious SIP and maintained because there was little change in the number of commercial customers using natural gas between the 2008 Moderate SIP baseline and this 2013 Serious SIP baseline inventory. However, based on information provided by one of the local heating oil suppliers in commenting on the Serious SIP Preliminary Draft inventory combined with the #1 and #2 heating oil splits in the residential sector, it was estimated that commercial fuel oil was almost entirely #1 distillate oil. So commercial heating oil was assumed to be 100% #1 distillate.

In addition, ADEC conducted a survey in early 2017 of solid fuel burning (wood or coal) in commercial buildings. The survey utilized a local business database provided by the Borough's Planning Department and group businesses into categories more or less likely to utilize a solid fuel burning appliance. Roughly 30 commercial businesses were found to utilize solid fuel burning and identified the type of device used. Many also provided estimates of their solid fuel usage. For those that did not, estimates were developed based on the building size assuming solid fuel burning was a secondary, rather than primary heating source. As shown later, commercial solid fuel space heating emissions were found to be very small compared to the residential sector based on these estimates.

Space Heating Emission Factors - Space heating emissions were estimated using OMNI-based results where available for specific devices and AP-42-based estimates for devices for which OMNI tests were not conducted. Table 7 shows the device and fuel types resolved in estimating space heating emissions for the modeling inventory, their assigned SCC codes, and the source of the emission factors (OMNI testing or AP-42-based) used in calculating emissions for each device.

[11] The energy demand factor was in units of BTU/HDD/ft^2/year. Commercial space heating energy per day was then calculated by multiplying the energy demand factor by building space (in ft^2) and day-specific HDDs.

Table 7
Fairbanks Space Heating Devices and Fuel Types and Source of Emission Factors

Device Type	SCC Code	Emission Factor
Residential Wood-Burning Devices		
Fireplace, No Insert	2104008100	AP-42
Fireplace, With Insert - Non-EPA Certified	2104008210	AP-42
Fireplace, With Insert - EPA Certified Non-Catalytic	2104008220	AP-42
Fireplace, With Insert - EPA Certified Catalytic	2104008230	AP-42
Woodstove - Non-EPA Certified	2104008310	OMNI
Woodstove - EPA Certified Non-Catalytic	2104008320	OMNI
Woodstove - EPA Certified Catalytic	2104008330	OMNI
Pellet Stove (Exempt)	2104008410	OMNI
Pellet Stove (EPA Certified)	2104008420	OMNI
OWB (Hydronic Heater) - Unqualified	2104008610	OMNI
OWB (Hydronic Heater) - Phase 2	2104008640	OMNI
Other Heating Devices		
Central Oil (Weighted # 1 & #2), Residential	2104004000	OMNI
Central Oil (Weighted # 1 & #2), Commercial	2103004001	OMNI
Portable Heater: 43% Kerosene & 57% Fuel Oil	2104004000	AP-42
Direct Vent Oil Heater	2104004000	AP-42
Natural Gas - Residential	2104006010	AP-42
Natural Gas - Commercial, small uncontrolled	2103006000	AP-42
Coal Boiler – Residential	2104002000	OMNI
Coal Boiler – Commercial	2103002000	OMNI[a]
Wood Devices - Commercial	2103008000	Device Specific[b]
Waste Oil Burning	2102012000	OMNI

[a] Assumed same emission factors as residential coal heaters.

[b] Used wood burning device specific emission factors from residential sector.

Episodic day- and hour-specific emissions from space heating fuel combustion were calculated by combining heating energy use estimates from the Fairbanks Energy Model with 4 km square grid cell device distributions from the local survey data (along with wood species mix and moisture content data). Estimates were gridded to the smaller 1.33 km modeling grid cells using block-level GIS shapefile counts of housing units from the 2010 U.S. Census combined with 2013 block-group level housing unit estimates from the American Community Survey (ACS).[12] The grid cell-specific source activity estimates were then combined with emission factors for the devices listed in Table 7 to estimate space heating emissions by grid cell.

The space heating emissions were passed to the SMOKE inventory pre-processing model on an episodic daily and hourly basis. Earlier versions of the SMOKE model accepted only nonpoint or area source emissions that were temporally resolved using independent monthly, day of week, and diurnal

[12] The American Community Survey is an on-going annual survey of households and businesses conducted by the U.S. Census Bureau between full decadal Census counts (https://www.census.gov/programs-surveys/acs/).

profiles. A modified version of SMOKE was developed for the Fairbanks SIP to also accept area source emissions in a similar fashion to which day- and hour-specific episodic point source emissions can be supplied to the model. This was critically important in preserving the actual historical temporal resolution reflected in the space heating portion of the modeling inventory when applied in the downstream attainment modeling.

Other Area Sources

Emission contributions from other area sources in Fairbanks during winter are relatively modest compared to those from space heating. As a result, the methods used to estimate emissions for all other sources within the area source sector (besides space heating) were less complex. However, they still relied on local data where it was available, rather than national defaults or a "top-down" approach. The data sources used to estimate "Other" area source emissions were as follows:

1. DEC's Minor Stationary Source emissions database (for calendar year 2014);
2. Locally-collected data for coffee roasting facilities within the nonattainment area; and
3. EPA's 2014 National Emission Inventory (NEI).

This section describes the data sources and methods used to estimate emissions from other non-space heating sources within the area source sector, beginning with the DEC's Minor Stationary Source database.

DEC Minor Stationary Sources

Emissions for sources within the Fairbanks North Star Borough were extracted from the 2014 Minor Source database for the following source types and SCCs:

- Batch Mix Asphalt Plant (SCC 30500247);
- Drum Hot Mix Asphalt Plants (SCC 30500258);
- Gold Mine (SCC 10200502);
- Hospital (SCC 20200402);
- Refinery (SCC 30600106);
- Rock Crusher (SCC 30504030); and
- Wood Production (SCC 10300208).

Emissions for these sources from the 2014 Minor Source file were actual emissions in tons per year and are summarized in Table 8. In the Arctic, asphalt plants are not operated during winter. For these source categories along with Rock Crushers, winter nonattainment season activity and emissions were assumed to be zero. For all other source categories listed above, emissions were assumed to be constant throughout the year.

Table 8
2014 DEC Minor Stationary Source Emissions within Fairbanks North Star Borough by SCC Code

Source Category	SCC Code	2014 Emissions (tons/year)				
		CO	NOx	SO_2	PM[a]	VOC
Batch Mix Asphalt Plants	30500247	0.18	0.39	0.05	0.04	0.03
Drum Hot Mix Asphalt Plants	30500258	0.99	11.41	1.23	2.23	2.11
Gold Mines	10200502	5.50	1.40	4.20	1.90	0.00
Hospitals	20200402	6.14	14.30	0.01	0.00	4.24
Refineries	30600106	13.77	23.80	0.50	3.00	9.50
Rock Crushers	30504030	76.31	61.79	5.86	49.08	17.87
Wood Production	10300208	0.00	5.38	0.00	5.94	7.32
Total Minor Sources		**102.90**	**118.47**	**11.85**	**62.19**	**41.08**

[a] DEC's database did not separately report $PM_{2.5}$ and PM_{10}. All PM emissions were assumed to be $PM_{2.5}$.

Coffee Roasters

A Fairbanks Business database (with confirmation from Borough staff) was used to identify a total of four facilities within the nonattainment area that use on-site coffee roasters. These businesses were contacted and two of the four provided data on annual roasting throughput (tons of beans roasted). Throughput was conservatively estimated for the two non-reporting facilities based on the maximum from those that reported their throughput. Emission factors for PM, VOC and NOx from EPA's WebFIRE AP-42 database for batch roasters were used to calculate emissions. (No emission factors were available for SO_2 or NH_3). Uncontrolled emission factors were applied to three of the four facilities. The other facility utilizes a thermal oxidizer; its emission factors were based on WebFIRE factors for a batch roaster with a thermal oxidizer. Coffee roasting emissions were assumed to be constant throughout the year.

Table 9 shows the resulting emissions tabulated for the coffee roasters within the nonattainment area. It was assumed that the 2017 activity data for coffee roasters was identical to that in 2013; the estimates in Table 9 were applied directly within the 2013 baseline inventory.

Table 9
Coffee Roasting Emissions within the Fairbanks Nonattainment Area

Source Category	SCC Code	2017 Emissions (tons/year)		
		PM[a]	VOC	NOx
Coffee Roasters	30200220	0.0101	0.0021	0.0003

[a] DEC's database did not separately report $PM_{2.5}$ and PM_{10}. All PM emissions were assumed to be $PM_{2.5}$.

Remaining Sources - 2014 NEI

The 2014 NEI was used to represent SCC-level annual emissions for all other remaining area source categories that included fugitive dust, commercial cooking, solvent use, forest and structural fires and petroleum project storage and transfer. Several source categories within the Other Area Source sector from the NEI were estimated to have no emissions during episodic wintertime conditions. These "zeroed" wintertime source categories are listed as follows (with SCC codes in parentheses).

- Fugitive Dust, Paved Roads (2294000000)
- Fugitive Dust, Unpaved Roads (2296000000)
- Industrial Processes, Petroleum Refining, Asphalt Paving Materials (2306010000)
- Solvent Utilization, Surface Coating, Architectural Coatings (2401001000)
- Solvent Utilization, Miscellaneous Commercial, Asphalt Application (2461020000)
- Miscellaneous Area Sources, Other Combustion, Forest Wildfires (2810001000)
- Miscellaneous Area Sources, Other Combustion, Firefighting Training (2810035000)
- Waste Disposal, Open Burning (2610000100-500, 2610030000).

Some of these source categories, notably those for fugitive dust and forest wildfires, have significant summer season (and annual average) emissions; however, emissions from these categories do not occur during winter conditions in Fairbanks when road and land surfaces are covered by snow and ice.

For all other categories except Construction Dust (SCC 2311010000) emissions were assumed constant throughout the year. Based on discussions with Borough staff, constructions dust was split 37% in winter months (October-March) and 63% in summer months (April-September).

Table 10 provides a listing of annual emissions (tons/year) by SCC code for these remaining other area source categories for the Fairbanks North Star Borough that were extracted from the 2014 NEI. (Though not shown, similar data were extracted for the other three counties within the modeling domain, Denali, Southeast Fairbanks and Yukon-Koyukuk.)

2014 emissions from the Minor Stationary Source database and the NEI were backcasted to 2013 using historical year-to-year county-wide population estimates compiled by the Alaska Department of Labor and Workforce Development (ADLWD). The 2013-2014 population growth factor for Fairbanks from the historical ADLWD data was 1.013, reflecting a 1.3% increase from 2013 to 2014. Thus, emissions were backcasted to 2013 by dividing 2014 emissions by 1.013.

Table 10
Remaining 2014 NEI-Based Other Area Source Emissions in Fairbanks North Star Borough by SCC Code

SOURCE DESCRIPTION	SCC	2014 ANNUAL EMISSIONS (tons/year)						
		VOC	NOx	SOx	NH3	PM25-PRI	PM25-FIL	PM-CON
Dust - Paved Road Dust - Mobile Sources - Paved Roads - All Paved Roads - Total: Fugitives	2294000000	0.0	0.0	0.0	0.0	114.3	114.3	0.0
Dust - Unpaved Road Dust - Mobile Sources - Unpaved Roads - All Unpaved Roads - Total: Fugitives	2296000000	0.0	0.0	0.0	0.0	1651.3	1651.3	0.0
Commercial Cooking - Industrial Processes - Food and Kindred Products: SIC 20 - Commercial Cooking - Charbroiling - Conveyorized Charbroiling	2302002100	0.6	0.0	0.0	0.0	2.5	0.0	2.5

SOURCE DESCRIPTION	SCC	2014 ANNUAL EMISSIONS (tons/year)						
		VOC	NOx	SOx	NH3	PM25-PRI	PM25-FIL	PM-CON
Commercial Cooking - Industrial Processes - Food and Kindred Products: SIC 20 - Commercial Cooking - Charbroiling - Under-fired Charbroiling	2302002200	2.0	0.0	0.0	0.0	16.1	0.0	16.0
Commercial Cooking - Industrial Processes - Food and Kindred Products: SIC 20 - Commercial Cooking - Frying - Clamshell Griddle Frying	2302003200	0.2	0.0	0.0	0.0	0.2	0.2	0.0
Commercial Cooking - Industrial Processes - Food and Kindred Products: SIC 20 - Commercial Cooking - Frying - Deep Fat Fying	2302003000	3.3	0.0	0.0	0.0	0.0	0.0	0.0
Commercial Cooking - Industrial Processes - Food and Kindred Products: SIC 20 - Commercial Cooking - Frying - Flat Griddle Frying	2302003100	0.3	0.0	0.0	0.0	3.3	0.0	3.3
Industrial Processes - Petroleum Refineries - Industrial Processes - Petroleum Refining: SIC 29 - Asphalt Paving/Roofing Materials - Total	2306010000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solvent - Non-Industrial Surface Coating - Solvent Utilization - Surface Coating - Architectural Coatings - Total: All Solvent Types	2401001000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solvent - Consumer & Commercial Solvent Use - Solvent Utilization - Miscellaneous Non-industrial: Commercial - Asphalt Application: All Processes - Total: All Solvent Types	2461020000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gas Stations - Storage and Transport - Petroleum and Petroleum Product Storage - Gasoline Service Stations - Stage 2: Spillage	2501060103	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gas Stations - Storage and Transport - Petroleum and Petroleum Product Storage - Gasoline Service Stations - Stage 2: Displacement Loss/Controlled	2501060102	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Industrial Processes - Storage and Transfer - Storage and Transport - Petroleum and Petroleum Product Storage - All Storage Types: Working Loss - Gasoline	2501995120	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Industrial Processes - Storage and Transfer - Storage and Transport - Petroleum and Petroleum Product Storage - All Storage Types: Breathing Loss - Gasoline	2501000120	0.0	0.0	0.0	0.0	0.0	0.0	0.0

SOURCE DESCRIPTION	SCC	2014 ANNUAL EMISSIONS (tons/year)						
		VOC	NOx	SOx	NH3	PM25-PRI	PM25-FIL	PM-CON
Fires - Wildfires - Miscellaneous Area Sources - Other Combustion - Forest Wildfires - Wildfires	2810001000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Miscellaneous Non-Industrial NEC - Miscellaneous Area Sources - Other Combustion - Structure Fires - Unspecified	2810030000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Miscellaneous Non-Industrial NEC - Miscellaneous Area Sources - Other Combustion - Firefighting Training - Total	2810035000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fuel Comb - Industrial Boilers, ICEs - Coal - Stationary Source Fuel Combustion - Industrial - Bituminous/Subbituminous Coal - Total: All Boiler Types	2102002000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fuel Comb - Industrial Boilers, ICEs - Oil - Stationary Source Fuel Combustion - Industrial - Distillate Oil - Total: Boilers and IC Engines	2102004000	23.7	66.1	4.9	0.0	5.9	1.6	4.3
Fuel Comb - Industrial Boilers, ICEs - Oil - Stationary Source Fuel Combustion - Industrial - Residual Oil - Total: All Boiler Types	2102005000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fuel Comb - Industrial Boilers, ICEs - Natural Gas - Stationary Source Fuel Combustion - Industrial - Natural Gas - Total: Boilers and IC Engines	2102006000	29.0	528.2	3.2	16.9	2.3	0.6	1.7
Fuel Comb - Industrial Boilers, ICEs - Oil - Stationary Source Fuel Combustion - Industrial - Kerosene - Total: All Boiler Types	2102011000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Industrial Processes - Oil & Gas Production - Industrial Processes - Oil and Gas Exploration and Production - All Processes - Total: All Processes	2310000000	9.9	23.7	1.0	0.0	3.0	3.0	0.0
Industrial Processes - Oil & Gas Production - Industrial Processes - Oil and Gas Exploration and Production - All Processes : On-shore - Total: All Processes	2310001000	9.9	23.7	1.0	0.0	3.0	0.0	0.0
Dust - Construction Dust - Industrial Processes - Construction: SIC 15 - 17 - Residential - Total	2311010000	0.0	0.0	0.0	0.0	0.5	0.5	0.0
Dust - Construction Dust - Industrial Processes - Construction: SIC 15 - 17 - Industrial/Commercial/Institutional - Total	2311020000	0.0	0.0	0.0	0.0	55.4	55.4	0.0

SOURCE DESCRIPTION	SCC	2014 ANNUAL EMISSIONS (tons/year)						
		VOC	NOx	SOx	NH3	PM25-PRI	PM25-FIL	PM-CON
Solvent - Industrial Surface Coating & Solvent Use - Solvent Utilization - Surface Coating - Traffic Markings - Total: All Solvent Types	2401008000	21.6	0.0	0.0	0.0	0.0	0.0	0.0
Solvent - Industrial Surface Coating & Solvent Use - Solvent Utilization - Surface Coating - Machinery and Equipment: SIC 35 - Total: All Solvent Types	2401055000	1.0	0.0	0.0	0.0	0.0	0.0	0.0
Solvent - Industrial Surface Coating & Solvent Use - Solvent Utilization - Surface Coating - Miscellaneous Manufacturing - Total: All Solvent Types	2401090000	2.2	0.0	0.0	0.0	0.0	0.0	0.0
Solvent - Degreasing - Solvent Utilization - Degreasing - All Processes/All Industries - Total: All Solvent Types	2415000000	49.0	0.0	0.0	0.0	0.0	0.0	0.0
Solvent - Dry Cleaning - Solvent Utilization - Dry Cleaning - All Processes - Total: All Solvent Types	2420000000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solvent - Graphic Arts - Solvent Utilization - Graphic Arts - All Processes - Total: All Solvent Types	2425000000	36.6	0.0	0.0	0.0	0.0	0.0	0.0
Solvent - Consumer & Commercial Solvent Use - Solvent Utilization - Miscellaneous Non-industrial: Consumer and Commercial - All Personal Care Products - Total: All Solvent Types	2460100000	99.5	0.0	0.0	0.0	0.0	0.0	0.0
Solvent - Consumer & Commercial Solvent Use - Solvent Utilization - Miscellaneous Non-industrial: Consumer and Commercial - All Household Products - Total: All Solvent Types	2460200000	109.5	0.0	0.0	0.0	0.0	0.0	0.0
Solvent - Consumer & Commercial Solvent Use - Solvent Utilization - Miscellaneous Non-industrial: Consumer and Commercial - All Automotive Aftermarket Products - Total: All Solvent Types	2460400000	67.7	0.0	0.0	0.0	0.0	0.0	0.0
Solvent - Consumer & Commercial Solvent Use - Solvent Utilization - Miscellaneous Non-industrial: Consumer and Commercial - All Coatings and Related Products - Total: All Solvent Types	2460500000	47.3	0.0	0.0	0.0	0.0	0.0	0.0

SOURCE DESCRIPTION	SCC	2014 ANNUAL EMISSIONS (tons/year)						
		VOC	NOx	SOx	NH3	PM25-PRI	PM25-FIL	PM-CON
Solvent - Consumer & Commercial Solvent Use - Solvent Utilization - Miscellaneous Non-industrial: Consumer and Commercial - All Adhesives and Sealants - Total: All Solvent Types	2460600000	28.4	0.0	0.0	0.0	0.0	0.0	0.0
Solvent - Consumer & Commercial Solvent Use - Solvent Utilization - Miscellaneous Non-industrial: Consumer and Commercial - All FIFRA Related Products - Total: All Solvent Types	2460800000	88.6	0.0	0.0	0.0	0.0	0.0	0.0
Solvent - Consumer & Commercial Solvent Use - Solvent Utilization - Miscellaneous Non-industrial: Consumer and Commercial - Miscellaneous Products (Not Otherwise Covered) - Total: All Solvent Types	2460900000	3.5	0.0	0.0	0.0	0.0	0.0	0.0
Solvent - Consumer & Commercial Solvent Use - Solvent Utilization - Miscellaneous Non-industrial: Commercial - Emulsified Asphalt - Total: All Solvent Types	2461022000	9.6	0.0	0.0	0.0	0.0	0.0	0.0
Miscellaneous Non-Industrial NEC - Storage and Transport - Petroleum and Petroleum Product Storage - Residential Portable Gas Cans - Permeation	2501011011	2.5	0.0	0.0	0.0	0.0	0.0	0.0
Miscellaneous Non-Industrial NEC - Storage and Transport - Petroleum and Petroleum Product Storage - Residential Portable Gas Cans - Evaporation (includes Diurnal losses)	2501011012	2.8	0.0	0.0	0.0	0.0	0.0	0.0
Miscellaneous Non-Industrial NEC - Storage and Transport - Petroleum and Petroleum Product Storage - Residential Portable Gas Cans - Spillage During Transport	2501011013	2.2	0.0	0.0	0.0	0.0	0.0	0.0
Miscellaneous Non-Industrial NEC - Storage and Transport - Petroleum and Petroleum Product Storage - Residential Portable Gas Cans - Refilling at the Pump - Vapor Displacement	2501011014	0.4	0.0	0.0	0.0	0.0	0.0	0.0

SOURCE DESCRIPTION	SCC	2014 ANNUAL EMISSIONS (tons/year)						
		VOC	NOx	SOx	NH3	PM25-PRI	PM25-FIL	PM-CON
Miscellaneous Non-Industrial NEC - Storage and Transport - Petroleum and Petroleum Product Storage - Residential Portable Gas Cans - Refilling at the Pump - Spillage	2501011015	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Miscellaneous Non-Industrial NEC - Storage and Transport - Petroleum and Petroleum Product Storage - Commercial Portable Gas Cans - Permeation	2501012011	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Miscellaneous Non-Industrial NEC - Storage and Transport - Petroleum and Petroleum Product Storage - Commercial Portable Gas Cans - Evaporation (includes Diurnal losses)	2501012012	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Miscellaneous Non-Industrial NEC - Storage and Transport - Petroleum and Petroleum Product Storage - Commercial Portable Gas Cans - Spillage During Transport	2501012013	3.0	0.0	0.0	0.0	0.0	0.0	0.0
Miscellaneous Non-Industrial NEC - Storage and Transport - Petroleum and Petroleum Product Storage - Commercial Portable Gas Cans - Refilling at the Pump - Vapor Displacement	2501012014	1.2	0.0	0.0	0.0	0.0	0.0	0.0
Miscellaneous Non-Industrial NEC - Storage and Transport - Petroleum and Petroleum Product Storage - Commercial Portable Gas Cans - Refilling at the Pump - Spillage	2501012015	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Bulk Gasoline Terminals - Storage and Transport - Petroleum and Petroleum Product Storage - Bulk Terminals: All Evaporative Losses - Gasoline	2501050120	1.0	0.0	0.0	0.0	0.0	0.0	0.0
Gas Stations - Storage and Transport - Petroleum and Petroleum Product Storage - Gasoline Service Stations - Stage 1: Submerged Filling	2501060051	29.3	0.0	0.0	0.0	0.0	0.0	0.0
Gas Stations - Storage and Transport - Petroleum and Petroleum Product Storage - Gasoline Service Stations - Stage 1: Splash Filling	2501060052	8.5	0.0	0.0	0.0	0.0	0.0	0.0
Gas Stations - Storage and Transport - Petroleum and Petroleum Product Storage - Gasoline Service Stations - Stage 1: Balanced Submerged Filling	2501060053	12.7	0.0	0.0	0.0	0.0	0.0	0.0

SOURCE DESCRIPTION	SCC	2014 ANNUAL EMISSIONS (tons/year)						
		VOC	NOx	SOx	NH3	PM25-PRI	PM25-FIL	PM-CON
Gas Stations - Storage and Transport - Petroleum and Petroleum Product Storage - Gasoline Service Stations - Underground Tank: Breathing and Emptying	2501060201	8.6	0.0	0.0	0.0	0.0	0.0	0.0
Gas Stations - Storage and Transport - Petroleum and Petroleum Product Storage - Airports : Aviation Gasoline - Stage 1: Total	2501080050	38.2	0.0	0.0	0.0	0.0	0.0	0.0
Gas Stations - Storage and Transport - Petroleum and Petroleum Product Storage - Airports : Aviation Gasoline - Stage 2: Total	2501080100	3.9	0.0	0.0	0.0	0.0	0.0	0.0
Industrial Processes - Storage and Transfer - Storage and Transport - Petroleum and Petroleum Product Transport - Truck - Gasoline	2505030120	0.6	0.0	0.0	0.0	0.0	0.0	0.0
Industrial Processes - Storage and Transfer - Storage and Transport - Petroleum and Petroleum Product Transport - Pipeline - Gasoline	2505040120	7.0	0.0	0.0	0.0	0.0	0.0	0.0
Industrial Processes - Mining - Industrial Processes - Mining and Quarrying: SIC 14 - All Processes - Total	2325000000	3.0	17.8	1.0	0.0	3.9	3.9	0.0
Waste Disposal - Waste Disposal, Treatment, and Recovery - Open Burning - All Categories - Yard Waste - Leaf Species Unspecified	2610000100	1.9	0.4	0.1	0.0	1.2	1.2	0.0
Waste Disposal - Waste Disposal, Treatment, and Recovery - Open Burning - All Categories - Yard Waste - Brush Species Unspecified	2610000400	1.3	0.3	0.1	0.0	1.0	1.0	0.0
Waste Disposal - Waste Disposal, Treatment, and Recovery - Open Burning - All Categories - Land Clearing Debris (use 28-10-005-000 for Logging Debris Burning)	2610000500	73.0	31.5	10.4	0.0	82.5	82.5	0.0
Waste Disposal - Waste Disposal, Treatment, and Recovery - Open Burning - Residential - Household Waste (use 26-10-000-xxx for Yard Wastes)	2610030000	12.7	8.9	1.5	0.0	51.4	51.4	0.0
Waste Disposal - Waste Disposal, Treatment, and Recovery - Landfills - Municipal - Total	2620030000	0.0	2.0	3.0	0.0	0.1	0.1	0.0

SOURCE DESCRIPTION	SCC	2014 ANNUAL EMISSIONS (tons/year)						
		VOC	NOx	SOx	NH3	PM25-PRI	PM25-FIL	PM-CON
Miscellaneous Non-Industrial NEC - Miscellaneous Area Sources - Other Combustion - Charcoal Grilling - Residential (see 23-02-002-xxx for Commercial) - Total	2810025000	1.4	1.7	0.0	0.0	4.4	0.0	0.0
Totals, 2014 NEI Sources		**858**	**704**	**26.1**	**16.9**	**2002**	**1967**	**27.8**

On-Road Mobile Sources

Emissions from on-road motor vehicles were developed within the 2013 Baseline modeling inventory using locally developed vehicle travel activity estimates and fleet characteristics as inputs to EPA's MOVES2014b vehicle emissions model. To support the gridded inventory structure and episodic (daily/hourly) emission estimates of the modeling inventory, MOVES2014b was used to generate detailed fleet emission rates and was combined with EPA's SMOKE-MOVES integration tool to pass the highly resolved and emission process-specific emission rates into input structures required by the SMOKE inventory pre-processing model.

For the 2013 Baseline inventory, MOVES inputs were based primarily on data gathered in support of the Fairbanks Metropolitan Area Transportation System (FMATS) 2045 Metropolitan Transportation Program (MTP). FMATS (now FAST Planning) is the Metropolitan Planning Organization (MPO) for the FNSB. Inputs were derived from local transportation modeling runs conducted to support the 2045 MTP, vehicle registration data, and other local data. The transportation and other vehicle activity data are discussed below along with fleet characteristics and other MOVES inputs developed to represent vehicle activity in Fairbanks.

Regional Travel Model Vehicle Activity – Vehicle activity on the FMATS/FAST Planning transportation network was based on the TransCAD travel demand modeling performed for the 2045 MTP. The TransCAD modeling network covers the entire FNSB $PM_{2.5}$ nonattainment area and its major links extend beyond the nonattainment area boundary, as illustrated in Figure 6.

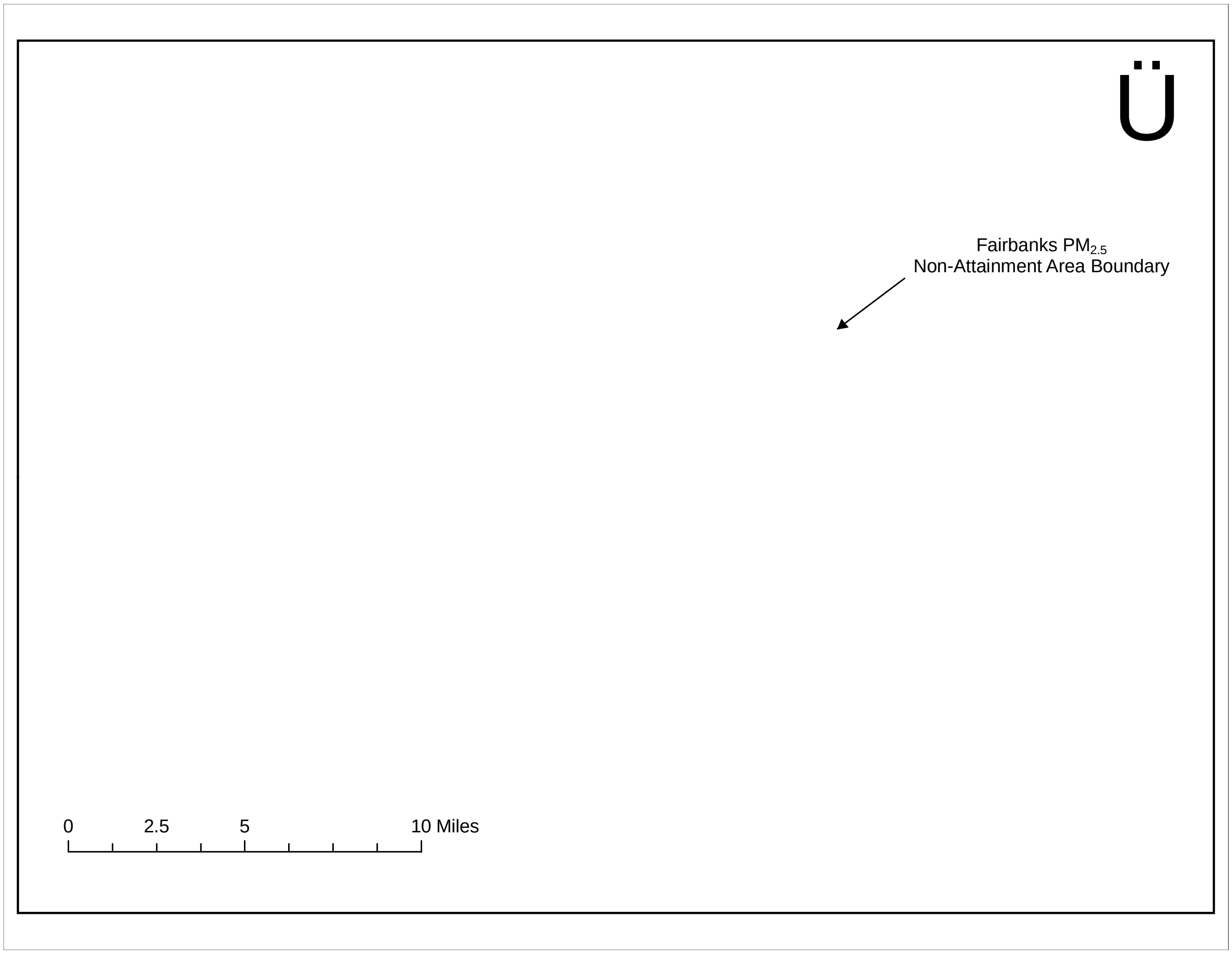


Figure 6. FMATS/FAST Planning TransCAD Modeling Network

TransCAD was configured using 2010 U.S. Census-based socioeconomic data. TransCAD modeling was performed for a 2013 base year and a projected 2045 horizon year. Projected population and household data relied on Census 2010 projections and a 1.1% annual growth rate in forecasted employment from 2010 to 2013 based on the information from the Institute of Social and Economic Research (ISER) at the University of Alaska, Anchorage.

2045 MTP travel model outputs were obtained from FAST Planning for 2013, 2019, 2024, 2025, 2029, 2035 and 2045. Link-level TransCAD outputs were processed to develop several of the travel activity related inputs required by MOVES. Vehicle miles traveled (VMT) tabulated across the TransCAD network for each of the years for which Final 2045 MTP travel model outputs were available are presented in Table 11.

Table 11
TransCAD Average Daily VMT by Year and Daily Period (Final 2045 MTP Forecast)

Daily Period	2013	2019	2024	2025	2029	2035	2045
Entire TransCAD Modeling Network							
AM Peak	253,497	276,312	309,883	315,267	335,153	363,142	414,901
PM Peak	501,870	558,215	634,785	646,926	692,378	756,436	866,833
Off Peak	1,374,276	1,524,386	1,730,719	1,762,352	1,882,479	2,051,737	2,337,955
Daily Total	**2,129,642**	**2,358,912**	**2,675,387**	**2,724,546**	**2,910,010**	**3,171,315**	**3,619,689**
VMT Growth (2013=1.0)		1.108	1.256	1.279	1.366	1.489	1.700
PM Nonattainment Area							
AM Peak	205,465	220,221	244,801	248,669	262,920	282,982	320,515
PM Peak	400,283	439,227	495,365	504,213	536,915	582,865	662,054
Off Peak	1,092,896	1,195,145	1,345,403	1,368,250	1,453,659	1,573,484	1,774,618
Daily Total	**1,698,644**	**1,854,594**	**2,085,569**	**2,121,132**	**2,253,495**	**2,439,331**	**2,757,187**
VMT Growth (2013=1.0)		1.092	1.228	1.249	1.327	1.436	1.623

Fleet Characteristics – Vehicle populations, age distributions and fleet mix characteristics (e.g., Alternative Vehicle Fuel and Technology inputs) were developed using Alaska DMV registration data obtained in May 2014, coupled with earlier wintertime parking lot survey data collected by ADEC to support the Moderate Area SIP. Multiple parking lots survey have consistently found that older vehicles are operated less in the FNSB area during winter due to drivability concerns associated with the arctic climate. The parking lot data were used to adjust the DMV-based age distributions for light-duty vehicles to reflect less operation of older vehicles during winter. In developing the episodic inputs, motorcycles were also assumed to not operate during harsh winter conditions and their populations were zeroed out (consistent with the approach applied in the Moderate Area SIP). Use of these DMV and parking lot survey data to develop the MOVES fleet characteristics is described in detail below.

The DMV database includes vehicle make, model, model year, Vehicle Identification Number (VIN), vehicle class code, body style, registration status and expiration date. Using a VIN decoding tool licensed by ADEC, supplemental information such as vehicle class, gross vehicle weight, vehicle type, body type and fuel type (e.g., gasoline vs. diesel) were also determined in order to help classify each vehicle into one of the 13 MOVES Source Use Type categories. Vehicle attribute fields from the DMV database (Class Code, Body Style), and VIN decoder outputs (Vehicle Class, GVWR Class, Vehicle Type, Body Type) were used to categorize each vehicle record into one of the 13 usage-based “Source Type” categories as defined in MOVES to characterize the vehicle fleet.

Table 12 lists each of these “Source Type” categories and identifies the primary vehicle attribute fields in either the DMV database itself (DMV) or output from the VIN decoder (Decoder) that were used to determine the Source Type for each vehicle record. For nearly all the records, the Source Type could be conclusively determined from specific combinations of these attributes.

Table 12
MOVES Vehicle Fleet Source Type Categories

Source Type ID	Source Type Description	Primary Attributes/Sources
11	Motorcycle	Class Code (DMV), Body Style (DMV) – Categories MB and MC, Vehicle Type (Decoder), Vehicle Class (Decoder)
21	Passenger Car	Class Code (DMV), Vehicle Type (Decoder) , Vehicle Class (Decoder)
31	Passenger Truck	Class Code (DMV), Vehicle Type (Decoder) , Vehicle Class (Decoder)
32	Light Commercial Truck	Class Code (DMV), Vehicle Class (Decoder), GVWR Class (Decoder) – up to Class 4 (14,001-16,000 lb)
41	Intercity Bus	Class Code (DMV), Body Style (DMV), Vehicle Type (Decoder), Vehicle Class (Decoder)
42	Transit Bus	Class Code (DMV), Body Style (DMV), Vehicle Type (Decoder), Vehicle Class (Decoder)
43	School Bus	Class Code (DMV), Body Style (DMV), Vehicle Type (Decoder), Vehicle Class (Decoder)
51	Refuse Truck	Body Style (DMV) – Category GG
52	Single Unit Short-haul Truck	Class Code (DMV), Body Style (DMV), Vehicle Class (Decoder), GVWR Class (Decoder) – Class 6 and above
53	Single Unit Long-haul Truck	Apportioned from MOVES default 52/53 splits
54	Motor Home	Body Style (DMV) – Category MH
61	Combination Short-haul Truck	Class Code (DMV), Body Style (DMV), Vehicle Class (Decoder) – Category “Truck Tractor”, GVWR Class (Decoder), Fuel Type (Decoder)
62	Combination Long-haul Truck	Apportioned from MOVES default 61/62 splits

In some cases, such as Source Types 51 (Refuse Trucks) and 54 (Motorhomes), single values of the Body Style field in the DMV database were used to discern the appropriate Source Type. In other cases, Source Types were assigned based on categorical values in several attribute fields as noted in Table 12. In a few cases, vehicle make and model fields were also examined and then fed to a web-based search engine to identify whether the vehicle was a single or combination-unit truck.

As also noted in Table 12, the DMV and VIN decoder attribute data were not sufficient to distinguish between short-haul trucks (Source Types 52 and 61) and long-haul trucks (Source Types 53 and 62). All of the single and combination-unit truck records were assigned short-haul Source Type categories of either 52 or 61. The *SourceTypeYear* table in the MOVES database was then queried to extract nationwide vehicle populations for Source Type categories 52, 53, 61 and 62. Relative splits between short- and long-haul vehicle fractions in these categories were then calculated and used to estimate the populations of long-haul single-unit (53) and combination-unit (62) vehicles in the Fairbanks fleet.

Table 13 shows the resulting summation of vehicles by their sourceTypeID as determined from the VIN decoder and DMV data for the year 2014. The 2014 population data was scaled back to 2013 values by backcasting the vehicle population based on the VMT rates of growth from 2013 to 2019. The VMT growth rates are derived for each individual HPMS vehicle type ID and then translated to MOVES source type ID. For the light duty vehicle fleet, the annual rate of change in VMT was found to be 1.5%. The 2013 backcasted populations are shown in the rightmost column of Table 13.

Table 13
Fairbanks Baseline Vehicle Populations by MOVES Source Type

Source Type ID	Source Type Description	Vehicle Populations	
		2014 DMV	2013 Backcast
11	Motorcycle	4,803	4,731
21	Passenger Car	26,847	26,442
31	Passenger Truck	62,691	61,746
32	Light Commercial Truck	4,707	4,636
41	Intercity Bus	146	144
42	Transit Bus	128	126
43	School Bus	181	178
51	Refuse Truck	72	71
52	Single Unit Short-haul Truck	1,283	1,264
53	Single Unit Long-haul Truck	55	54
54	Motor Home	1,757	1,731
61	Combination Short-haul Truck	663	653
62	Combination Long-haul Truck	791	779
Total Vehicle Fleet		**104,124**	**102,555**

[a] Motorcycle activity in Fairbanks during the winter months was assumed to be zero.

The DMV registration data also identified the model year of the vehicle, which enabled distributions of populations by vehicle age[13] to be calculated for each Source Type and input to MOVES. For the three light-duty passenger vehicle types (11-motorcycles, 21-passenger cars, and 31-passenger trucks), vehicle age distributions from winter parking lot surveys[14] conducted by ADEC in Fairbanks during January and February 2009 were used instead of those based on DMV registrations. This is because it was found in both these 2009 surveys as well as similar parking lot surveys conducted earlier by ADEC in 2005 and 2000 that older passenger vehicles are driven less during harsh winter conditions in Fairbanks.

[13] Vehicle age in years was simply calculated by subtracting the model year from 2010, the calendar year in which the DMV database obtained.
[14] The purpose of the surveys was to collect data for assessing the performance of the I/M Program. A review of the location of the surveys found broad representation beyond the boundary of the CO nonattainment area in Fairbanks, North Pole, and Chena Ridge areas. While no data were collected in Goldstream Valley, the results sufficiently represent the $PM_{2.5}$ nonattainment area to be used in the analysis.

Figure 7 compares the vehicle age fractions (by age group) for light-duty passenger cars in Fairbanks developed from the DMV registrations and the Parking Lot Surveys. As Figure 7 clearly shows, vehicle fractions in the newer groups (< 15 years) from the Parking Lot Surveys are distinctly higher than from the DMV registrations. This pattern is reversed for the older vehicle groups (15 or more years old).

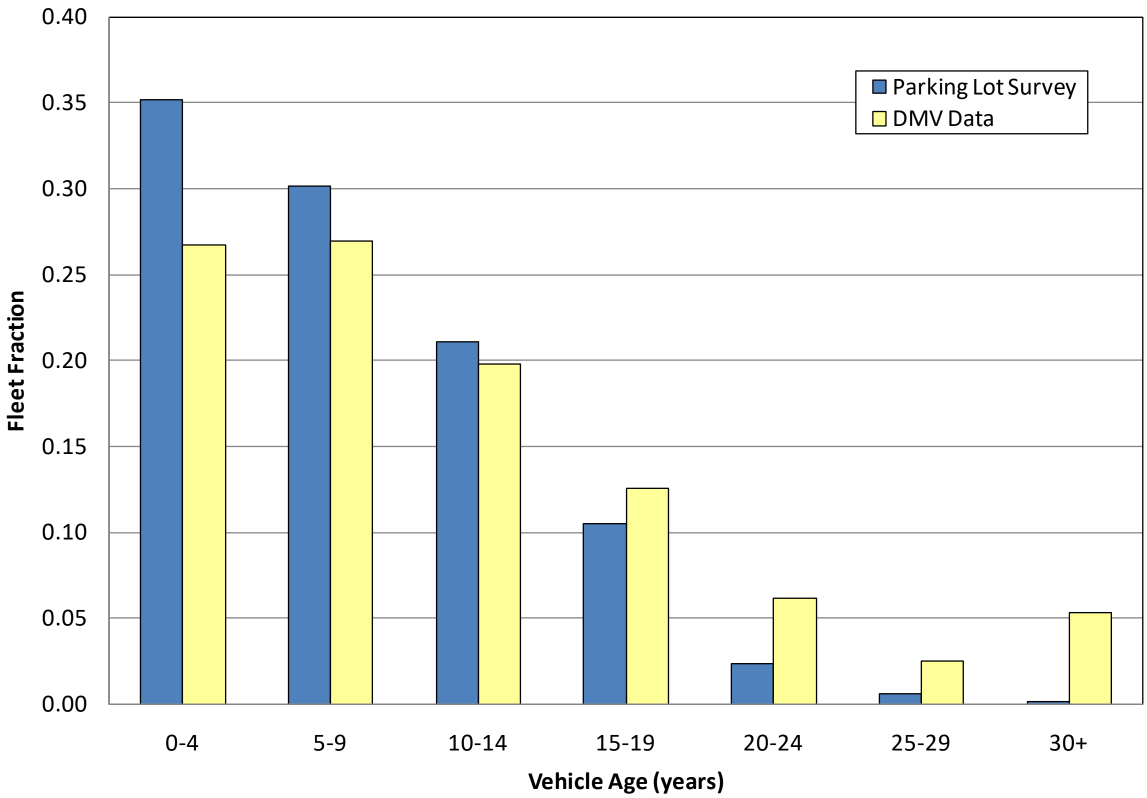


Figure 7. Comparison of DMV and Survey-Based Passenger Car Age Distributions

Another expected finding from the Fairbanks parking lot surveys is that motorcycles are simply not operated during cold wintertime conditions. Although motorcycles make up roughly 5% of the Fairbanks-registered vehicle fleet as shown earlier in Table 13, only a single motorcycle was identified in the entire sample of over 8,500 vehicles from the 2009 Fairbanks surveys (which represents 0.01% of the survey sample). Thus, for Source Type categories 11 (motorcycles), 21 (passenger cars) and 31 (passenger trucks), vehicle age distributions were based on the Parking Lot Survey data to reflect well-documented winter season shifts toward greater use of newer vehicles in the passenger car and passenger truck fleets as well as non-use of motorcycles during winter months.

For the remaining MOVES source type categories (32 and above), age distributions were based on the DMV registration data for Fairbanks. The age distributions developed for the 2013 Baseline fleet were projected to future calendar year fleets using EPA's MOVES2014-based Age Distribution Projection Tool.[15]

[15] https://www.epa.gov/moves/tools-develop-or-convert-moves-inputs#fleet

MOVES provides users the ability to override its default nationwide based travel splits between different fuels and technologies using the Alternative Vehicle Fuel and Technology (AVFT) input.

In order to account for differences in splits between gasoline- and diesel-fuel vehicles in the Fairbanks fleet compared to the U.S. as a whole, fuel fraction tables by source type and model year were also constructed using the DMV VIN decoded data described earlier. Not surprisingly, the MOVES default splits between gasoline and diesel vehicles was not representative of the Fairbanks fleet. Generally speaking, gasoline fractions were found to be lower in Fairbanks than the nationwide-based MOVES defaults (and diesel fractions were commensurately higher).

This is illustrated in Figure 8, which compares the gasoline vehicle fractions by model year for passenger trucks (MOVES Source Type 31) from the Fairbanks DMV data against the default fractions contained in MOVES. As seen in Figure 8 actual gasoline vehicle fractions for passenger trucks in Fairbanks are roughly 10% lower than the MOVES defaults (meaning diesel fractions are roughly 10% higher). Modest differences were also observed for some of the commercial vehicle categories as well.

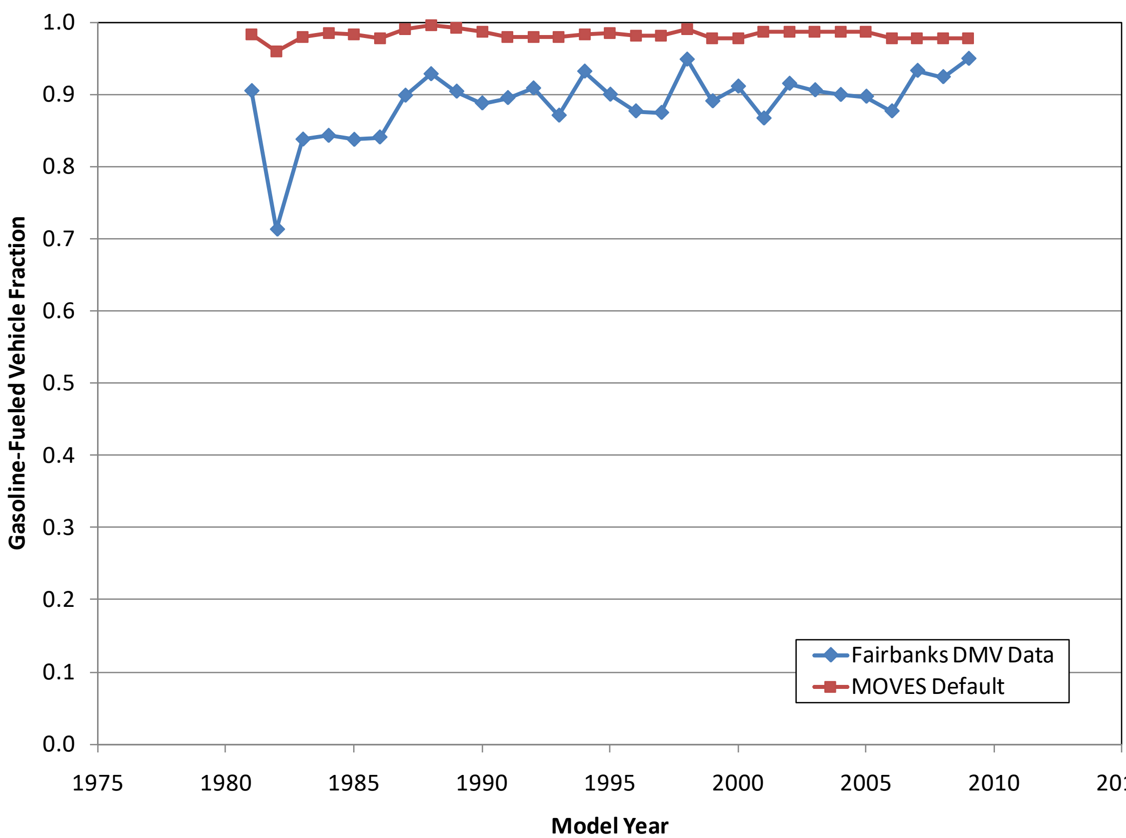


Figure 8. Comparison of Passenger Truck Gasoline-Fuel Vehicle Fractions by Model Year, Fairbanks DMV Data vs. MOVES Defaults

As illustrated by the range of model years compared in Figure 8, DMV VIN decoder-based gasoline vs. diesel vehicle fractions were available only for model years 1981 through 2009 (the VIN decoder only operates on 1981 and later models). In setting up the AVFT fuel split input to MOVES, the fuel fractions must be specified by model year, not vehicle age. For earlier model years prior to 1981, the MOVES default fractions were used. For model years 2014 and later, the DMV-based fuel type fractions from model year 2014 were generally assumed to remain constant in future model years except in the passenger truck category where the MOVES defaults reflect a modest increase in diesel penetration in future model years. For passenger trucks in model years 2014 and later, the MOVES defaults were used.

Monthly, Day-of-Week and Hourly VMT Fractions – In conjunction with VMT by HPMS Vehicle Type, MOVES also requires input of monthly, weekday/weekend, and hourly travel fractions. Based on data assembled by ADOT&PF from 2013 seasonal traffic counts, traffic within the FMATS modeling area exhibits a seasonal variation such that roughly 92% of annual average daily travel within the $PM_{2.5}$ nonattainment area occurs on average winter days (with 108% occurring on average summer days). These seasonal variations were incorporated into the MonthVMTFraction input table.

Day-of-week and hourly VMT fractions were similarly developed from the 2013 ADOT&PF data. The day-of-week fractions were then converted into Weekday vs. Weekend fractions as required for input to MOVES.

Travel by Speed Bin and Roadway Type (Average Speed & Road Type Distributions) – The link-level TransCAD model output files were also processed to prepare these two sets of MOVES inputs for each analysis year.

The roadway type classification scheme employed in MOVES consists of the following five categories:

1. Off-Network;
2. Rural, Restricted Access;
3. Rural, Unrestricted Access;
4. Urban, Restricted Access; and
5. Urban, Unrestricted Access.

The “Off-Network” category is used by MOVES to represent engine-off evaporative or starting emissions that occur off of the travel network. For SIP and regional conformity analysis, EPA’s MOVES guidance indicated that the user must supply Average Speed Distribution and Road Type Distribution inputs for the remaining on-network road types (2 through 5), but direct MOVES to calculate emissions over all five road types. In this manner, starting and evaporative emissions are properly calculated and output.

The first of the two sets of inputs, Average Speed Distributions, consists of time-based[16] (not distance-based) tabulations of the fractions of travel within each of MOVES’ 16 speed bins (at 5 mph-wide intervals) by road type and hour of the day. These inputs were calculated from the TransCAD link outputs by time of day. The TransCAD outputs consisted of travel times, average speeds and vehicle volumes for each link in the expanded modeling network for each of three daily periods:

1) AM Peak (7-9 AM);
2) PM Peak (3-6 PM); and
3) Off-Peak (9 AM-3 PM, plus 6 PM-7 AM).

[16] MOVES requires Average Speed Distribution inputs on a time-weighted basis and Road Type Distribution inputs on a distance-weighted basis.

Spreadsheet calculations were performed on the TransCAD link outputs to calculate time-based travel (multiplying link travel time by vehicle volume to get vehicle hours traveled or VHT) across all links. The link VHT was then allocated by MOVES road type and average speed bin. (The link classification scheme employed in the TransCAD modeling could easily be translated to the MOVES Rural/Urban and Limited/Unlimited Access road types.) Normalized speed distributions (across all 16 bins) were then calculated for each road type and time of day period and formatted for input into MOVES.

Similar spreadsheet calculations were also performed to tabulate distance-based (i.e., VMT-based) Road Type Distribution inputs to MOVES.

Freeway Ramp Fractions (Ramp Fraction) – MOVES uses default values of 8% (or 0.08) to represent the fraction of time-based limited access roadway travel (Road Types 2 and 4) that occur on freeway ramps. Fairbanks-specific ramp fraction values were tabulated from the TransCAD link level outputs and were supplied to MOVES in the Ramp Fraction input section of the County Data Manager to override the nationwide-based defaults.

Ambient Temperature Profiles (Meteorology Data) – Episodic average temperature profiles were created per the guidance in the SMOKE-MOVES model documentation using the MET4MOVES. Some MET4MOVES code modifications were made to allow for sub-monthly temperature profiles to be generated. Code changes are detailed in the SMOKE modeling appendix. Different temperature profiles are required as inputs for a number of MOVES runs to create lookup tables for rate per distance, rate per vehicle and rate per profile activities. The modified MET4MOVES program was operated using a version of the run_met4moves.csh script included with the 2.7.1 version of SMOKE. The dates of the episode days, surrogates and ASSIGNS file were updated to reflect the SMOKE configuration for the baseline modeling episodes. Two script runs of the *run_met4moves.csh* file were performed to generate different average meteorology profiles for each episode. The MET4MOVES program requires the met field inputs already be processed through the Meteorology-Chemistry Input Processor (MCIP) software.

The domain-wide ground level average relative humidity (RH), minimum and maximum temperatures for each modeling episode are presented in **Error! Reference source not found.**. These outputs have been rounded down to the nearest 5-degree increment in the case of the minimum temperature and up to the nearest 5-degree increment in the maximum temperature case.

Table 14
Fairbanks Model Domain Episodic Meteorology Conditions

Episode	Relative Humidity	Min. Temperature (F)	Max.Temperature (F)
Episode 1 (Jan - Feb)	72.3%	-50.0	30.0
Episode 2 (Nov)	82.3%	-20.0	35.0

Daily temperature profiles for each of the episodes are presented in Table 15. These profiles have been scaled to reflect the maximum and minimum temperatures for those respective episodes. These profiles form the basis of the RPV and RPP MOVES simulation meteorology inputs that are generated by the RunSpec generator script. (The RunSpec generator script was rewritten to use the average RH, minimum temperature, maximum temperature and average profiles to create the RPD, RPV and RPP meteorology input fields.)

Table 15
Fairbanks Model Domain Episodic Average Temperature Profiles

Hour	Episode 1 Temperature (F)	Episode 2 Temperature (F)
1	-33.7	-17.8
2	-38.0	-20.0
3	-42.9	-18.5
4	-47.2	-13.1
5	-48.2	-16.2
6	-46.4	-17.1
7	-46.6	-15.6
8	-48.5	-19.8
9	-50.0	-18.8
10	-48.9	-18.2
11	-48.7	-9.0
12	-36.5	4.7
13	-10.6	14.7
14	15.7	26.6
15	30.0	35.0
16	29.1	32.3
17	12.3	19.7
18	-3.0	8.9
19	-11.6	0.8
20	-18.1	1.4
21	-22.1	-2.1
22	-26.2	-9.8
23	-31.4	-14.0
24	-29.2	-17.4

<u>I/M Program Data (I/M Programs)</u> – Since the Fairbanks Inspection and Maintenance (I/M) program was terminated at the end of 2009, the "Use I/M Program" input element to MOVES was set from "Yes" to "No" to account for the elimination of the program.

<u>Fuel Property Inputs</u> – Fuel property inputs (e.g., fuel volatility, sulfur level, ethanol volume, aromatic, olefins and benzene content, etc.) were based on MOVES defaults for Fairbanks with one exception discussed below. In MOVES2014b, Fairbanks is grouped within Fuel Region 6, which includes Alaska and rural portions of California, Nevada, Arizona and Hawaii where Reformulated Gasoline (RFG) is not required. In consultation with EPA, the defaults were chosen over industry-based survey data[17] collected in Fairbanks which tend to be limited to a small number of fuel samples. The MOVES default fuel properties for this non-RFG region assume a 10% ethanol blend level in gasoline. Although this "E10" blend level is used for gasoline in the lower-48, there is no ethanol blending in Alaska. Thus, the MOVES2014b "Fuel Wizard" tool was used to zero the gasoline ethanol content and properly adjust the other fuel properties that would be affected by this change. The Fuel Wizard has been designed in

[17] Bi-annual fuel surveys across 30 U.S. cities conducted by the Alliance of Automobile Manufacturers 1999-2017.

MOVES2014b to be consistent with EPA refinery modeling based on the Tier 3 Motor Vehicle Emissions and Fuel Standards rulemaking.

Table 16 shows the MOVES2014b gasoline fuel properties used for Fairbanks for calendar year 2013 and years 2017 and later (2017+) before and after the Fuel Wizard-based ethanol adjustment to the defaults. (The “Null” values for T50 are as-extracted from the MOVES database, indicating this value is not defined in the default database.) Diesel fuel defaults for Fuel Region 6 were not changed.

Table 16
MOVES2014b Gasoline Fuel Properties Before and After Ethanol Adjustment

	MOVES2014b Defaults		Fuel-Wizard Adjusted	
Fuel Property	**2013**	**2017+**	**2013**	**2017+**
RVP (psi)	11.6	11.4	10.6	10.4
Sulfur Level (ppm)	30.0	10.0	30.0	10.0
Ethanol (% vol)	10	10	0	0
Aromatic Content (% vol)	22.1	21.4	25.7	25.0
Olefin Content (% vol)	7.1	6.7	9.1	8.7
Benzene Content (% vol)	0.7	0.7	0.7	0.7
e200 (% vol)	53.7	53.7	47.9	48.8
e300 (% vol)	87.4	87.4	86.7	86.8
T50 (deg F)	Null	Null	204.2	202.2
T90 (deg F)	194.2	192.2	312.7	312.0

Plug-In Adjustments to $PM_{2.5}$ Emissions – Finally, starting exhaust $PM_{2.5}$ emissions for light-duty gasoline vehicles were adjusted to account for the effects of wintertime vehicle plug-in block heater use in Fairbanks.

Table 17 summarizes the reductions in starting exhaust $PM_{2.5}$ developed from measured data in the Fairbanks 2010-2011 Plug-In Testing program resulting from use of plug-ins while a vehicle is parked or “soaked.” The column “Default Daily Soak Dist” lists the daily average soak time fractions extracted from MOVES2014b model for light-duty vehicles. The next column, “% $PM_{2.5}$ Redn” shows relative starting exhaust $PM_{2.5}$ emission reductions developed from the measurement data as a function of soak time. The plug-in reductions are expressed as percentages relative to the emissions of the vehicle if it had not been plugged in when parked. Only reductions for $PM_{2.5}$ are shown. (Although plug-in effects were also measured for gaseous pollutants, only directly emitted $PM_{2.5}$ reductions are being applied for the SIP inventory adjustments.)

The six rightmost columns in Table 17 show plug-in usage fractions (percentage of trips) as a function of both soak time and ambient temperature (daily average temperature). The soak time intervals correspond to those defined in EPA’s MOVES2014b model. The ambient temperature range is shown from -50°F to 0°F in 10-degree increments. At the bottom of Table 17, daily composite plug-in usage fractions and $PM_{2.5}$ starting exhaust reductions are shown.

Table 17
Local Measurement-Based Starting Exhaust $PM_{2.5}$ Emission Reductions from Plug-In Use

OpMode ID	Soak Time Intervals (min.)	Default Daily Soak Dist.	% $PM_{2.5}$ Redn	% Plug-In Use as a Function of Soak Time (minutes) and Daily Ambient Temperature (°F)					
				-50°F	-40°F	-30°F	-20°F	-10°F	0°F
101	Soak Time < 6	0.185	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
102	6 ≤ to < 30	0.205	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
103	30 ≤ to < 60	0.096	4.4%	25.9%	14.0%	2.4%	0.0%	0.0%	0.0%
104	60 ≤ to < 90	0.058	7.3%	44.4%	32.5%	20.8%	9.4%	0.0%	0.0%
105	90 ≤ to < 120	0.042	10.3%	56.6%	44.7%	33.1%	21.6%	10.4%	0.0%
106	120 ≤ to < 360	0.162	23.5%	86.8%	74.9%	63.2%	51.8%	40.6%	29.6%
107	360 ≤ to < 720	0.114	53.0%	100.0%	100.0%	93.1%	81.7%	70.5%	59.5%
108	720 ≤ Soak Time	0.139	70.8%	100.0%	100.0%	100.0%	100.0%	89.4%	78.4%
Daily Composite Plug-In Trip Fraction (%)				39.9%	35.9%	31.3%	27.4%	22.6%	18.5%
Daily Composite Plug-In $PM_{2.5}$ Reduction (%)				16.4%	15.9%	15.1%	14.1%	12.2%	10.4%

The average ambient temperature over the modeling episode days was -11.8°F, which yields a plug-in $PM_{2.5}$ reduction (applied to starting exhaust light-duty gasoline vehicles) of 12.5% based on the analysis spreadsheet developed to compute plug-in benefits as a function of soak time and ambient temperature.

These adjustments were applied using an EPA- accepted approach that consisted of modifying the MOVES soak time distribution inputs for light-duty vehicles contained in *OpModeDistribution* table in the model's default database.

Non-Road Mobile Sources

Non-road sources encompass all mobile sources that are not on-road vehicles.[18] They include recreational and commercial off-road vehicles and equipment as well as aircraft, locomotives, recreational pleasure craft (boats) and marine vessels. (Neither commercial marine nor recreational vessel emissions are contained in the modeling inventory, as they do not operate in the arctic conditions experienced in the Fairbanks area modeling domain during the winter.)

Non-Road Vehicles and Equipment

Non-road vehicle emissions were estimated using EPA's latest MOVES model, MOVES2014b (EPA integrated what used to be a standalone model for estimating non-road mobile source emissions, called NONROAD, into MOVES2014). According to EPA's MOVES release notes,[19] MOVES2014b contains significant improvements in estimating non-road emissions relative to its predecessor, MOVES2014a (On-road emissions are identical in MOVES2014a and MOVES2014b). The non-road emissions option

[18] Although recent versions of EPA's NEI inventories treat emissions for aircraft and supporting equipment and rail yard locomotive emissions as stationary sources, emissions from these sources were "traditionally" located within the Non-Road source sector. For consistency with the Moderate SIP, these sources are similarly grouped within the Non-Road sector.
[19] https://www.epa.gov/moves/latest-version-motor-vehicle-emission-simulator-moves

within MOVES2014b was used to generate emissions from the following types of non-road vehicles and equipment:

- Recreational vehicles (e.g., all-terrain vehicles, off-road motorcycles, snowmobiles);
- Logging equipment (e.g., chain saws);
- Agricultural equipment (e.g., tractors);
- Commercial equipment (e.g., welders and compressors);
- Construction and mining equipment (e.g., graders and backhoes);
- Industrial equipment (e.g., forklifts and sweepers);
- Residential and commercial lawn and garden equipment (e.g., leaf and snow blowers);
- Locomotive support/railway maintenance equipment (but not locomotives); and
- Aircraft ground support equipment[20] (but not aircraft).

It is important to note that none of these non-road vehicle and equipment types listed above were federally regulated until the mid-1990s. (As parenthetically indicated for the last two equipment categories in the list above, MOVES2014b estimates emissions of support equipment for the rail and air sectors, but emissions from locomotives and aircraft are not addressed by MOVES2014b and were calculated separately using other models/methods as described later within this subsection.)

Default equipment populations and activity levels in MOVES2014b are based on national averages, then scaled down to represent smaller geographic areas on the basis of human population and proximity to recreational, industrial, and commercial facilities. EPA recognizes the limitations inherent in this “top-down” approach, and realizes that locally generated inputs to the model will increase the accuracy of the resulting output. Therefore, in cases where data were available (most notably snowmobiles and snow blowers), locally derived inputs that more accurately reflect the equipment population, growth rates, and wintertime activity levels in the Fairbanks nonattainment area were substituted for EPA’s default input values.

Calculation Methodology – MOVES/NONROAD model calculates emissions from each source category according to the following methodology:

$$\boldsymbol{Emissions = EF \times DF \times P \times LF \times Hours \times Units}$$

Where:

EF = emission factor in g/hp-hr;
DF = deterioration factor (dimensionless);
P = engine power in horsepower;
LF = load factor (dimensionless);
Hours = annual operating hours for each engine (unit); and
Units = total population of engines operating in a given year.

[20] Although MOVES2014b can be configured to also estimate emissions from airport ground support equipment (GSE), GSE emissions were estimated using the AEDT model as described later in this sub-section.

The above calculation yields emissions in grams per year, which MOVES/NONROAD then converts to tons per year. For seasonal or daily emissions estimates, the calculated annual emissions for each source are then distributed over a given number of calendar months. For example, NONROAD assumes by default that all snowmobile activity takes place during the winter months, which are defined by the model to be December, January, and February. For this analysis, several modifications were made to equipment population growth rates, seasonal activity distribution, and annual operating hours and equipment populations. Summarized below are the specific modifications made to EPA's default MOVES/NONROAD inputs.

Equipment Growth Rates – MOVES/NONROAD model predicts future equipment populations using national growth rates that have been determined using nationwide historical engine population estimates (i.e., for 1989 through 1996) from the Power Systems Research (PSR) PartsLink database. Given the relatively flat, and in some cases negative population growth predicted for Alaska's interior region, it is believed that the default NONROAD growth rates do not provide an accurate representation of equipment population growth trends in the 2013 through 2019 timeframe. For example, the default NONROAD growth factor results in a 2.8% annual increase in the snowmobile population in Fairbanks between 2010 and 2020—a figure that is twice as high as the annual human population growth rate predicted by the Alaska Department of Labor & Workforce Development for this area over the same period.

As shown in Table 18, a relatively flat annual growth rate of 1.4% for the total population of Alaska's interior region is predicted through 2020, which includes a negative growth rate in some of the smaller areas surrounding the Fairbanks nonattainment area. Therefore, to better reflect 2019 and later year equipment populations in the Fairbanks nonattainment area, the human population projections for the individual interior regions shown in Table 1 were used as surrogate equipment population growth rates for all non-road equipment modeling performed for this inventory.

Table 18
Alaska Interior Region Human Population by Area (2010 to 2020)

Interior Region	July 1, 2010	July 1, 2015	July 1, 2020	Annual Growth Rate (2010-2020)
Denali Borough	1,826	1,796	1,752	-0.41%
Fairbanks North Star Borough	98,000	105,928	113,275	1.56%
Southeast Fairbanks Census Area	7,055	7,635	8,141	1.54%
Yukon-Koyukuk Census Area	5,615	5,288	5,001	-1.09%
Interior Region Total	112,496	120,647	128,169	1.39%

Modifications to Snowmobile Inputs – Because most of the wintertime non-road emissions in the Fairbanks area are associated with snowmobile activity, it was important to utilize all available FNSB-specific input NONROAD modeling parameters for this equipment category. This analysis was performed using the following modifications to NONROAD's snowmobile inputs:

Snowmobile Populations – The current version of EPA's NONROAD model predicts a calendar year (CY) 2010 population of 12,193 snowmobiles in the Borough, which is very close to the 12,420 snowmobiles registered in FNSB for that same year.[21] However, snowmobile populations in the areas surrounding FNSB did not approximate DMV registration data as closely as in the Borough, as shown in Table 19 below. Consequently, the CY2014 DMV registration totals shown below were substituted for the default NONROAD snowmobile population.

Table 19
Alaska Interior Region Snowmobile Population by Area for CY 2014

Interior Region	NONROAD Default Population	Alaska DMV Registrations
Denali Borough	168	410
Fairbanks North Star Borough	12,193	12,420
Southeast Fairbanks Census Area	518	1,115
Yukon-Koyukuk Census Area	567	808

Although the emission inventory presented in this appendix encompasses the $PM_{2.5}$ nonattainment area within the FNSB, the multi-county data shown above (from the larger modeling domain inventory for Serious Area SIP) illustrate the approach used to check and reconcile MOVES default populations.

Snowmobile Activity – Snowmobile use inside the urban nonattainment area is largely banned because of public safety ordinances that prohibit their use on public trails and on public roadways. To address the fact that most snowmobile activity takes place outside the nonattainment area, the NONROAD default annual activity rate of 57 hours/year/unit was applied to only half of the FNSB snowmobile population. In addition, to account for loading, unloading, and maintenance activities that presumably take place inside the nonattainment area, an additional 1 hour/year/unit of snowmobile activity was assumed for the entire snowmobile population. All other snowmobile activity is assumed to occur in areas outside the Borough and/or the nonattainment area.

<u>Snow Blowers</u> – For purposes of this analysis, emissions from this equipment source were assumed to be zero. $PM_{2.5}$ violations (and consequently, $PM_{2.5}$ design days) always occur when there is a strong inversion layer over the region, rather than during periods of snow activity when snow blowers are typically used. Therefore, since snow blowers are not typically in use on the $PM_{2.5}$ design day, we have discounted their emissions from this analysis.

<u>Nonexistent Wintertime Activity</u> – Due to the severe outdoor weather conditions present in Fairbanks during the winter months, FNSB staff has determined that there is zero wintertime activity for a number of different equipment categories. Therefore, all activity and corresponding emissions for the following non-road equipment categories have been removed from this analysis:

- Lawn and Garden;
- Agricultural Equipment;

[21] Data obtained from the Alaska Division of Motor Vehicles (DMV).

- Logging Equipment;
- Pleasure Craft (i.e., personal watercraft, inboard and sterndrive motor boats);
- Selected Recreational Equipment (i.e., golf carts, ATVs, off-road motorcycles); and
- Commercial Equipment (i.e., generator sets, pressure washers, welders, pumps, A/C refrigeration units).

Selected equipment from the following categories was retained, as follows:

- Construction and Mining – Graders, off-highway trucks, rubber tire dozers, and rubber tire loaders were retained to represent snow removal equipment activity.
- Industrial Equipment – Equipment that primarily operates indoors (such as forklifts, aerial lifts, and terminal tractors) was retained.

Equipment Not Included in NONROAD Model – Discussions with FNSB staff[22] indicate that indirect-fired temporary Diesel and propane heaters are commonly used in FNSB in connection with any indoor construction or repair work performed during the winter months. These heaters are in constant use (24 hours/day, 7 days/week) during the six-month FNSB winter period while regular indoor heating systems at construction sites are non-operational. Because these heaters are not included on the NONROAD model equipment list, we have calculated emissions from this source separately, as shown below in Table 20 and Table 21.

FNSB staff has estimated that a total of 30 heaters (10 small propane and 20 large Diesel units) operate continually at various construction sites during the winter months. Unit heating capacity was obtained from vendor specifications.[23]

Table 20
Emissions from Indirect-Fired Temporary Heaters - Diesel

# units	Unit Heating Capacity (Btu/hr)	Fuel Heat Value (Btu/gallon)	Emission Factors (lb/1000 gallons) (AP-42, Table 1.3-1)				
			NO_x	CO	PM	THC	SO_x
20	2,000,000	138,500	10	5	2	0.556	0.61
Tons/Year from All Units:			6.3	3.2	1.3	0.35	0.39

22 Personal communication between Glenn Miller (FNSB) and Bob Dulla (Sierra Research), 3/4/2013.
23 http://www.etopp.com/indirect-fired-temporary-heaters.html.

Table 21
Emissions from Indirect-Fired Temporary Heaters - Propane

# units	Unit Heating Capacity (Btu/hr)	Fuel Heat Value (Btu/ft^3)	Emission Factors (lb/10^6 ft^3) (AP-42, Table 4-1)				
			NOx	CO	PM	THC	SO_x
10	450,000	2,500	100	21	4.5	5.8	0.426
Tons/Year from All Units:			0.39	0.08	0.02	0.02	0.002

These indirect-fired temporary heater emissions were added to the inventory and assumed to occur only during winter months. The Source Classification Codes (SCCs) assigned to these heaters were as follows:

- SCC 2270002000 – Mobile Sources, Off-highway Vehicle Diesel, Construction and Mining Equipment, Total; and
- SCC 2267002000 – Mobile Sources, LPG, Construction and Mining Equipment, All.

Fuel and Temperature Inputs – NONROAD modeling runs were executed for the four counties within the $PM_{2.5}$ modeling domain:

1. Fairbanks North Star Borough (FNSB);
2. Denali Borough;
3. Southeast Fairbanks Census Area; and
4. Yukon-Koyukuk Census Area.

As noted earlier, only the $PM_{2.5}$ nonattainment area portion of the FNSB was used for the inventory described in this appendix.

For each of these counties, calendar year 2013 and later wintertime fuel parameters for both gasoline and diesel fueled equipment were set to correspond to the levels EPA has assumed in the MOVES2014b model for FNSB. This reflects the fact that mobile source fuel in interior Alaska is refined locally. So the same gasoline and diesel refinery blends are used in both on-road and non-road sources in Fairbanks. Table 22 below shows both the NONROAD default values and the FNSB fuel parameters and temperature inputs used in this MOVES/NONROAD modeling effort.

Table 22
NONROAD Modeling Wintertime Fuel and Temperature Inputs

Fuel Parameter	MOVES/NONROAD Default	CY 2013 & Later
Gasoline RVP	8.0	14.7
Gas Oxygen Weight (%)	2.44	0.0
Gas Sulfur (%)	0.0339	0.0028
Diesel Sulfur (%)	0.0351	0.0011
Marine Diesel Sulfur (%)	0.0435	0.0011
CNG/LPG Sulfur (%)	0.003	0.003
Stage II Control (%)	0	0
EtOH Blend Market (%)	75.1	0
EtOH Volume (%)	9.3	0
Minimum Temperature (^oF)	-	-15.7
Maximum Temperature (^oF)	-	4.0
Average Temperature (^oF)	-	-6.0

Spatial Allocation – In the absence of well-developed, source-specific surrogates for Alaska[24], MOVES/Non-road outputs were spatially allocated to individual grid cells in the modeling domain based on apportionment factors developed from block-level occupied household counts obtained from the 2010 U.S. Census. It was assumed that relative density of occupied households was a reasonable surrogate for allocating all SCC-specific categories from the MOVES/Non-road modeling runs with the exception of snowmobiles, which used a modified version of the Occupied Household surrogate based on allocations of snowmobile activity inside and outside the $PM_{2.5}$ non-attainment area that were discussed earlier in this sub-section.

Locomotive Emissions

Emissions for two types of locomotive activity were included in the emission inventory:

1. *Line-Haul* – locomotive emissions along rail lines within the modeling domain (from Healy to Fairbanks and Fairbanks to Eielson Air Force Base); and
2. *Yard Switching* – locomotive emissions from train switching activities within the Fairbanks and Eielson rail yards.

Information on wintertime train activity (circa 2013) was obtained from the Alaska Railroad Corporation[25] (ARRC), the sole rail utility operating within the modeling domain, providing both

[24] EPA has developed a detailed set of SMOKE-ready surrogate files for use in spatial allocation down to 4 km grid cell sizes as described here: http://www.epa.gov/ttn/chief/emch/spatial/index.html. However, although the domain over which these surrogates were developed convers much of North American, is does not extend to Alaska.
[25] Email from Matthew Kelzenberg, Alaska Railroad Corporation to Alex Edwards, Alaska Department of Environmental Conservation, July 19, 2016.

passenger and freight service. These activity data were combined with locomotive emission factors published by EPA[26] to estimate rail emissions within the emission inventory.

Table 23 lists the train activity data by line segment and switching yard supplied by ARRC. Conversations with ARRC indicated that these November 2013 estimates were reasonably representative of the broader six-month winter season.

Table 23
Winter 2013 Train Activity by Line Segment and Yard

Line Segment or Switching Yard	November Avg. (# of trains/day)[1]	Hours of Operation	Miles (per train)	Locomotives (per train)[2]	Fuel Cons. (gal/train)[3]
Healy to Fairbanks	4.29	0001 - 1800	108	4	1210
Fairbanks to North Pole	1.7	2100 - 0800	17	2	95
North Pole to Eielson	1	0800 - 1600	12	1.5	50
Eielson to Ft. Greely	Zero	n/a	80	0	Zero
Fairbanks Yard	1	24 Hours	10	1.5	42
Eielson Yard[4]	1	8 Hours	5	1	14

Notes:
[1] The Healy to Fairbanks segment is based on average number of trains run in a week divided by seven days. The North Pole to Eielson value is an average number. ARRC does not go to Eielson from Fairbanks every day.
[2] Locomotive numbers from Fairbanks Operations Chief
[3] Fuel consumption from Mechanical Manager (~2.8 gallons/mi at average throttle speed)
[4] Eielson AFB has their own yard locomotives

Source: Alaska Railroad Corporation.

ARRC staff also indicated that train activity in this part of the state has been fairly flat from year to year. Thus, these 2013 estimates were assumed to be reasonably representative of future years. Given the modest rate of future economic growth forecasted for the Alaskan interior, the train activity shown in Table 23 was assumed constant in future year inventories through 2019.

These train activity data were combined with EPA-published locomotive emission factors which are presented in Table 7-6-24. In the absence of detailed locomotive age data from ARRC, the calendar year specific emission factors shown in Table 7-6-24 were based on Tables 5 through 7 of the cited EPA locomotives publication.

Emission factors for CO are constant across calendar year since the CO standard is the same across all locomotive Tier categories. Per EPA guidance, $PM_{2.5}$ emission factors were scaled from those for PM_{10} using a 97% scaling factor. SO_2 emission factors were also developed based on EPA guidance using estimates of diesel fuel density (3200 g/gal), sulfur to SO_2 conversion rate (97.5%) and fuel sulfur (15 ppm in 2012 and later from Alaska Ultra Low Sulfur Diesel[27] phase in).

[26] "Emission Factors for Locomotives," U.S. Environmental Protection Agency, Office of Transportation and Air Quality, EPA-420-F-09-025, April 2009.
[27] https://dec.alaska.gov/air/anpms/ulsd/ulsdhome.htm

Table 7-6-24
EPA Emission Factors (g/gal) for Locomotives by Calendar Year and Activity Type

Calendar Year	Activity Type	HC	CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2
2013	Large Line-Haul	6.5	26.6	139.0	3.8	3.7	0.09
2013	Large Switch	13.3	38.1	225.0	5.0	4.9	0.09
2019	Large Line-Haul	3.9	26.6	103.0	2.5	2.4	0.1
2019	Large Switch	11.4	38.1	200.0	4.4	4.3	0.1

Source: U.S. Environmental Protection Agency, EPA-420-F-09-025.

Spatial Allocation – Line-haul locomotive emissions over each of the rail segments listed in the preceding tables were spatially allocated to individual grid cells in the modeling domain using GIS software and a statewide rail line shapefile developed by the U.S. Department of Transportation. The allocations assumed a constant line-haul speed and thus were proportional to the lineal track length within each grid cell.

Yard-switching emissions were allocated to specific grid cells that encompassed the Fairbanks and Eielson rail yards using estimated apportionment factors that corresponded to the amounts of switching track lines within each cell.

Aircraft and Associated Airfield Emissions

Emissions were estimated from aircraft operations at three regional airfields within the modeling domain: 1) Fairbanks International Airport (FAI); 2) Fort Wainwright Army Post[28] (FBK); and 3) Eielson Air Force Base (EIL). The aircraft emissions were developed using the Federal Aviation Administration's (FAA) AEDT2c aircraft/airfield emissions model. AEDT considers the physical characteristics of each airport along with detailed meteorological and operations information in order to estimate the overall emissions of aircraft, ground support equipment (GSE) and auxiliary power units (APUs) at each airport. At the time the analysis was performed, AEDT2c was the latest available version.

AEDT Methodology Summary - The AEDT model requires as input detailed information on landings and take-offs (LTO) for each aircraft type in order to assign GSE and estimate the associated emissions. Each LTO is assumed to comprise six distinct aircraft related emissions modes: startup, taxi out, take off, climb out, approach, and taxi in. The AEDT modeled defaults for time in mode and angle of climb out and approach were used for purposes of this analysis. In order to properly allocate aircraft emissions to each vertical layer of analysis (elevation above ground level), aircraft emissions were estimated for each mode and ascribed to a specific vertical layer. The vertical grid structure established for the Fairbanks $PM_{2.5}$ attainment modeling consists of 38 vertical layers ranging between ground level and 100,000 feet as shown in Table 25. The current version of AEDT allows the user to vary the mixing height over a range from 1,000 feet to a maximum of 10,000 feet. Thus, shaded layers (1 through 21) in Table 25 represent those for which AEDT emissions were assigned or distributed as described below.

[28] Formerly Ladd Air Force Base.

Table 25
Vertical Layer Boundaries Included in the Emissions Analysis

Layer	Meters	Feet	Layer	Meters	Feet
1	0	0	20	2,408.84	7,903.01
2	4.00	13.13	21	2,922.27	9,587.47
3	8.00	26.26	22	3,470.92	11,387.50
4	12.81	42.03	23	4,059.98	13,320.13
5	23.63	77.54	24	4,695.90	15,406.45
6	46.94	153.99	25	5,386.76	17,673.05
7	67.89	222.73	26	6,142.97	20,154.05
8	112.79	370.05	27	6,978.19	22,894.28
9	177.96	583.87	28	7,910.89	25,954.32
10	276.73	907.91	29	8,966.86	29,418.78
11	410.35	1,346.28	30	10,126.79	33,224.30
12	546.23	1,792.09	31	11,416.93	37,457.05
13	684.46	2,245.61	32	12,875.50	42,242.38
14	825.13	2,707.10	33	14,512.04	47,611.59
15	968.31	3,176.85	34	16,445.80	53,955.93
16	1,150.96	3,776.12	35	18,747.26	61,506.62
17	1,375.80	4,513.78	36	21,744.80	71,341.08
18	1,646.36	5,401.43	37	25,751.01	84,484.76
19	1,987.69	6,521.28	38	32,139.07	105,442.93

Emissions associated with aircraft start up, taxi in or out, and take off, were assigned to Layer 2 (approximately 13 feet above ground level) to reflect average engine heights above ground. GSE and APU emissions were assigned to Layer 1. Climb out and approach emissions were ascribed proportionately between layers 2 and 11 (from 13 to approximately 1,300 feet) based upon the relative size of the distance between layer boundaries. Separate AEDT runs were made for each of the remaining 10 layers (Layers 12-21) with boundaries between 1,000 and 10,000 feet.

All AEDT runs assumed the minimum temperature allowable in default mode of -9.08°C (15.7°F). The following sub-sections separately describe the data sources, assumptions and methods used to generate AEDT-based aircraft emission estimates for each airfield.

<u>Fairbanks International Airport</u> - Fairbanks International Airport is a state-owned public-use airport located three miles (5 km) southwest of the central business district of Fairbanks in the Fairbanks North Star Borough of Alaska. Given the fact that FAI is positioned only 9.5 hours from 90% of the northern industrialized hemisphere and considering that the airport is open 24 hours a day (including holidays), FAI is convenient for servicing cargo airlines as a refueling stop for aircraft on trans-polar routes. FAI is also served by several passenger airlines.

Annual LTOs for FAI in 2013, 58,621, were obtained from the Alaska International Airport System (AIAS)[29]. However, these AIAS data did not include the distribution of LTOs by aircraft type. The LTO

[29] Alaska International Airport System – Statistics, Alaska Department of Transportation and Public Facilities, http://dot.alaska.gov/aias/stat2557scascca.shtml.

distribution by aircraft types was derived from the FAI Statistics System.[30] A report generated for January of 2013 included the activity of 45 air carriers utilizing 39 different types of aircraft. 92% of the reported LTOs were attributable to aircraft types that were included in the AEDT model. The remaining LTOs were either ascribed to similar aircraft with respect to manufacturer, size and purpose, or proportionately distributed among those aircraft types present in the model. Table 26 presents the distribution of 2013 LTOs by airframe for FAI used in the modeling.

Table 26
2013 LTOs by Aircraft Type for Fairbanks International Airport (FAI)

Airframe	LTOs
ATR 42-200, "-300", -400, and -500	15
ATR 72-"200", ATR 72-500	259
Airbus A319-100 Series	74
Raytheon Beech 1900-C, Raytheon Beech 1900-D	2297
Raytheon Super King Air 200	1
Raytheon Beech Bonanza 36	144
Raytheon Beech 18	287
Boeing 727-200 Series	1
Boeing 737-100 Series, Boeing 737-200 Series	3
Boeing 737-400 Series	3141
Boeing 737-700 Series	524
Boeing 737-800 Series	708
Boeing 737-900 Series	293
Boeing 747-400 Series	0
Boeing 757-200 Series	207
Boeing 767-300 Series, Boeing 767-300 ER	0
CASA 212-200 Series, "CASA 212-300 Series", CASA 212-400 Series	2
Cessna 208 Caravan	4806
Cessna 206, Cessna 210 Centurion	395
Boeing C-118	54
DeHavilland DHC-8-100	2152
Embraer EMB120 Brasilia	66
Helio U-10 Super Courier	115
Lockheed C-130 Hercules	61
Boeing DC-6	175
Boeing DC-9-30 Series	36
Boeing MD-11	2
Pilatus PC-12	186
Piper PA-31 Navajo	6266
Piper PA-32 Cherokee Six	282
HS125-8	1
Saab 340-B	1
Shorts 330	148
Boeing C-118	1404
Boeing DC-9-10 Series	117
Raytheon Beech 1900-C	273
Cessna 206	1170

[30] http://dot.alaska.gov/faiiap/index.shtml.

Airframe	LTOs
Cessna 208 Caravan	546
Cessna 210 Centurion	117
Helio U-10 Super Courier	351
Piper PA-31 Navajo	936
Raytheon Beech 18	195
Piper PA-32 Cherokee Six	390
Raytheon Beech Bonanza 36	117
Cessna 150 Series	2612
Cessna 172 Skyhawk	8539
Cessna 182	6238
Cessna 310	117
Cessna 337 Skymaster	117
Piper PA-23 Apache/Aztec	10839
Piper PA-24 Comanche	39
Piper PA-28 Cherokee Series	312
Piper PA-30 Twin Comanche	195
Piper PA-34 Seneca	39
Piper PA46-TP Meridian	78
Raytheon Beech 60 Duke	39
Lockheed C-130 Hercules	934
Boeing C-17A	47
Boeing 707-300 Series	16
Lockheed Martin F-16 Fighting Falcon	24
Boeing F/A-18 Hornet	8
Boeing KC-135 Stratotanker	55
Lockheed P-3 Orion	47
Lockheed S-3 Viking	8
TOTAL	**58,621**

In default mode, AEDT automatically assigns GSE and auxiliary power units (APU) to each LTO based upon airframe type. GSE include air conditioning units, air starts, aircraft tractors, baggage tractors, belt loaders, bobtails, cabin service trucks, cargo loaders, carts, catering trucks, deicers, fork lifts, fuel trucks, generators, ground power units, hydrant carts, lavatory trucks, lifts, passenger stands, service trucks, sweepers, water service trucks, and any other vehicles or equipment that tend to the aircraft while at the gate. Although APUs are most often on-board generators that provide electrical power to the aircraft while its engines are shut down, many aircraft utilize external generators. For purposes of this analysis, the AEDT defaults for GSE and APU age distribution, motive power and operating time per LTO were used. All GSE and APUs emissions were assigned to ground level as noted earlier. The AEDT estimated 2013 emission inventory for FAI is presented in Table 27.

Table 27
2013 FAI Emissions Inventory by Source Category (Metric Tons per Day)

Source	CO	THC	TOG	VOC	NOx	SOx	PM2.5	PM10
Aircraft	5.358	0.233	0.234	0.204	0.256	4.780	0.114	0.114
APU	0.009	0.001	0.001	0.001	0.004	0.001	0.001	0.001
GSE	0.127	0.000	0.005	0.005	0.020	0.000	0.001	0.001
Totals	**5.493**	**0.233**	**0.239**	**0.210**	**0.280**	**4.781**	**0.115**	**0.116**

Fort Wainwright/LADD Army Airfield **-** Fort Wainwright (FBK) is located adjacent to Fairbanks in the interior of Alaska in the Fairbanks North Star Borough about 365 miles north of Anchorage. Information regarding 2008 LTOs was obtained from FBK in the form of monthly average flights by group. (Annual LTOs were developed by multiplying the monthly averages by a factor of 12.)

Summaries of the type of aircraft in each of these groups are provided below:

- *Military/Local* - denotes activity by Army-owned aircraft stationed at Ladd Army Airfield which are all rotary-wing aircraft; CH-47 Chinook, UH-60 Blackhawks and OH-58 Kiowa Warriors. The monthly LTOs for this group were distributed according to the proportion of available aircraft.
- *Military/Transient* - reflects activity by military aircraft that utilize the airspace/airfield that are not stationed at Ladd Army Airfield. The aircraft inventory includes the A-10 Warthog, C-12 Huron, C-130 Hercules, C-17 Globe Master, F-16 Falcon and KC-135 Strato-Tanker. The monthly LTO for this group were assumed to be evenly distributed across the available airframes.
- *General Aviation/Local* - represents activity by Bureau of Land Management (BLM) owned aircraft stationed at Ladd Army Airfield. The aircraft mix in this group includes the Bell 212, Euro-Copter AS-350, Canadair CL-215 Scooper, CASA C-212 Avio-car, Cessna 206 Sky Wagon, Dornier 228 and Short Sherpa. The LTOs for this group were evenly distributed across all airframes.
- *General Aviation/Transient* - denotes activity by non-military aircraft not stationed at Ladd Army Airfield. The mix of aircraft in this group includes the Beech King Air 350, Boeing 737, Citation Cessna 552, Gulfstream Jet V, and Bell 206 Jet-Ranger.

As was the case with FAI, some of the aircraft in use at FBK were not found in the AEDT database. In these instances, alternative airframes were selected according to similarity, or the LTOs associated with those missing aircraft were proportionately distributed among the remainder of the fleet. The LTOs by aircraft used in the Fort Wainwright modeling are presented in Table 28.

GSE and APU assignment and emissions were modeled using the AEDT defaults. The resulting inventory for FBK is summarized in Table 29.

Table 28
2013 LTOs by Aircraft Type for Fort Wainwright/LADD Army Airfield (FBK)

Airframe	LTOs
Boeing CH-46 Sea Knight	2286
Sikorsky UH-60 Black Hawk	4382
Bell 206 JetRanger	5715
Cessna 182	0
Boeing C-17A	670
Boeing KC-135 Stratotanker	670
F16	670
Lockheed C-130 Hercules	167
Beechcraft C-12 Huron	167
Raytheon Beech 1900-C, Raytheon Beech 1900-D	167
Bell 214B-1	57
Eurocopter AS 355NP	57
Bombardier CL-415	57
CASA 212-200 , -300 and -400 Series	57
Cessna 206 and 210 Centurion	57
Dornier 228-200 Series	57
Shorts 330	57
Raytheon Super King Air 300	962
Boeing 737-400 Series	962
Cessna 552 T-47A	962
Gulfstream V-SP	962
Bell 206 JetRanger	962
Total	**40,206**

Table 29
2013 FBK Emissions Inventory by Source Category (Metric Tons per Day)

Source	CO	THC	TOG	VOC	NOx	SOx	PM2.5	PM10
Aircraft	0.112	0.035	0.040	0.040	0.416	4.094	0.078	0.078
APU	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GSE	0.042	0.000	0.002	0.002	0.011	0.000	0.001	0.001
Totals	**0.154**	**0.035**	**0.042**	**0.042**	**0.428**	**4.094**	**0.078**	**0.078**

Eielson Air Force Base - Eielson Air Force Base (EIL) is located approximately 26 miles (42 km) southeast of Fairbanks, Alaska in central Alaska's Fairbanks North Star Borough. North Pole is the nearest community to the base, located nine miles away. Established in 1943 as Mile 26 Satellite Field, Eielson is home to the 354th Fighter Wing which is part of the Eleventh Air Force (11 AF) of Pacific Air Forces.

Eielson plays an important role because of its strategic location. Aircraft movement information including take off, landings, touch-and-go, low approach, or aircraft passing though EIL airspace were provided by AFB personnel for February of 2008. It was estimated that some 1,100 aircraft movements per month (13,200 annual LTOs) were attributable to AFB operations with an approximately 60% / 40% military / civilian distribution.

The airframes assigned to EIL include the A-10 Thunderbolt II, C-123, F-4 Phantom II, F-16 Fighting Falcon, KC-135 Strato-Tanker, and the OV-10 Bronco. Lacking aircraft specific LTO information, it was assumed that each aircraft was equally likely to have contributed to overall emissions for the purposes of this analysis. Civilian traffic was attributed to the Piper PA-31 as the most frequent flyer found in the analysis of FAI. The assumed LTOs by aircraft type for EIL are included in Table 30.

Table 30
2013 LTOs by Aircraft Type for Eielson Air Force Base (EIL)

Airframe	LTOs
Rockwell Commander 500	1
Raytheon Super King Air 200	53
Raytheon King Air 90	1
Boeing DC-10-10 Series	5
Boeing DC-6	2
Boeing DC-9-30 Series	2
Boeing 707-300 Series	6
Boeing 737-700 Series	8
Boeing 737-800 Series	4
Boeing 747-400 Series	6
Boeing 757-200 Series	1
Boeing 767-200 Series	3
Boeing 767-300 Series, Boeing 767-300 ER	2
Boeing 777-200 Series	2
Boeing F-15 Eagle	220
Boeing C-17A	90
Boeing KC-135 Stratotanker	459
Bombardier Challenger 600	1
Cessna 208 Caravan	1
Cessna 560 Citation V	6
Cessna 172 Skyhawk	6
Convair CV-580	2
Fairchild A-10A Thunderbolt II	148
Fokker F27 Friendship	2
Rockwell Commander 690	1
Gulfstream G500	2
Gulfstream G100	1
Lockheed C-130 Hercules	116
Lockheed C-5 Galaxy	7
Lockheed Martin F-16 Fighting Falcon	1465
Lockheed P-3 Orion	10
Shorts 330-100 Series	6
Boeing F/A-18 Hornet	145
Pilatus Turbo Trainer PC-9	1
Gulfstream G300	7
F-16	0
F-16	0
Total	**5,580**

As for the other airfields, GSE and APU assignment and emissions were also modeled using the AEDT defaults. The resulting inventory for Eielson is presented in Table 31.

Table 31
2013 EIL Emissions Inventory by Source Category (Metric Tons per Day)

Source	CO	THC	TOG	VOC	NOx	SOx	PM2.5	PM10
Aircraft	0.171	0.114	0.132	0.131	0.137	1.876	0.048	0.048
APU	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GSE	0.003	0.000	0.000	0.000	0.003	0.000	0.000	0.000
Totals	**0.174**	**0.114**	**0.132**	**0.131**	**0.140**	**1.876**	**0.048**	**0.048**

Combined Airfield Emissions Inventory - Taken in the aggregate, the three airfields included in the current analysis contribute only modestly to the overall emissions of the region. A large fraction of emissions associated with aircraft take off, landing and related ground support equipment occur near ground level. Table 32 presents the combined emissions of the three analyzed airfields stratified by vertical layer. The emission units in Table 32 differ from those in the earlier airfield-specific tables. AEDT output units of metric tons were used in those tables. They have been converted to tons in Table 32 for comparison with other sectors of the emissions inventory. AEDT does not estimate ammonia (NH_3) emissions for aircraft; thus, they were assumed to be zero.

Table 32
2013 Combined Emissions Inventory of Aircraft Operations (Tons/Day)

Layer	VOC	CO	NO_x	SO_x	NH_3	PM_{10}	$PM_{2.5}$
1	0.0085	0.2000	0.0425	0.0013	0	0.0026	**0.0027**
2	0.1472	0.6319	0.0873	1.2878	0	0.0470	**0.0470**
3	0.0015	0.0241	0.0042	0.0665	0	0.0023	**0.0023**
4	0.0009	0.0145	0.0025	0.0399	0	0.0014	**0.0014**
5	0.0021	0.0325	0.0057	0.0900	0	0.0030	**0.0030**
6	0.0045	0.0701	0.0122	0.1937	0	0.0066	**0.0066**
7	0.0040	0.0630	0.0110	0.1741	0	0.0059	**0.0059**
8	0.0086	0.1350	0.0235	0.3732	0	0.0126	**0.0126**
9	0.0125	0.1959	0.0342	0.5417	0	0.0183	**0.0183**
10	0.0189	0.2970	0.0518	0.8209	0	0.0278	**0.0278**
11	0.0256	0.4017	0.0700	1.1105	0	0.0376	**0.0376**
12	0.0134	0.3179	0.0419	0.5978	0	0.0230	**0.0230**
13	0.0125	0.3170	0.0349	0.4942	0	0.0190	**0.0190**
14	0.0132	0.3174	0.0353	0.4954	0	0.0190	**0.0190**
15	0.0143	0.3231	0.0429	0.5640	0	0.0082	**0.0082**
16	0.0186	0.4086	0.0528	0.6647	0	0.0075	**0.0075**
17	0.0686	0.8585	0.0592	0.8806	0	0.0050	**0.0050**
18	0.0192	0.5035	0.0571	0.7014	0	0.0040	**0.0040**
19	0.0147	0.4810	0.0725	0.8012	0	0.0046	**0.0046**
20	0.0057	0.3754	0.0867	0.8687	0	0.0050	**0.0050**
21	0.0072	0.4494	0.1060	1.0832	0	0.0062	**0.0062**
Totals	**0.4217**	**6.4173**	**0.9341**	**11.8509**	**0**	**0.2666**	**0.2667**

Spatial Allocation – In addition to the vertical layer allocations represented in Table 32, simple horizontal allocations of aircraft emissions were developed within a GIS system based on a map overlay of each of the three airfields and the modeling domains grid cells. Ground-based and elevated (climb out and approach) emissions were distributed into the 3-5 specific grid cells that encompassed the runway and taxiway/terminal apron areas of each airfield. (Refined allocations of climb out and approach emissions by horizontal and vertical cell reflecting typical in-air flight trajectories at each airfield were not developed given the magnitude of airfield emissions relative to the entire emissions inventory and significance of ground-based sources under the limited vertical mixing characterizing winter $PM_{2.5}$ episodes in Fairbanks.)

2013 Baseline Emissions

2013 Baseline inventory emissions calculated using the data sources and methodologies summarized in the preceding paragraphs were tabulated by source sector and key subcategory and are presented as follows.

Table 33 shows 2013 Baseline emissions tabulated by source sector. (The Space Heating sector is further broken out into key fuel-specific subcategories.) Emissions are shown for both the entire Grid 3 modeling domain (Modeling Inventory) and the smaller $PM_{2.5}$ nonattainment area (Planning Inventory) and are presented on an average daily basis over the 35 episode days.

Table 33
2013 Baseline Episode Average Daily Emissions (tons/day) by Source Sector

Source Sector	$PM_{2.5}$	NOx	SO_2	VOC	NH_3
Point	1.23	10.45	7.22	0.23	0.051
Area, Space Heat, All	2.59	2.34	3.62	9.50	0.136
Area, Space Heat, Wood	2.43	0.40	0.08	9.29	0.091
Area, Space Heat, Oil	0.06	1.72	3.42	0.10	0.003
Area, Space Heat, Coal	0.08	0.05	0.10	0.11	0.013
Area, Space Heat, Other	0.01	0.16	0.02	0.01	0.028
Area, Other	0.22	1.72	0.03	2.27	0.045
On-Road Mobile	0.27	3.36	0.02	4.07	0.054
Non-Road Mobile	0.15	0.86	6.10	0.41	0.000
TOTALS	**4.46**	**18.73**	**17.00**	**16.48**	**0.286**

As seen in Table 33, directly-emitted $PM_{2.5}$ in the 2013 Baseline inventory is dominated by space heating emissions and almost entirely from wood-burning devices. Within the nonattainment area, wood-burning space heating contributes 2.43 tons/day of the total 4.46 tons/day of direct $PM_{2.5}$ from all sources, which is about 56%. For the gaseous precursor pollutants, point sources are the major contributors of NOx and SO_2 emissions. Most VOC and NH_3 emissions are produced by wood-burning space heating, with other contributions from mobile sources.

3. 2019 Control Inventory

Projected inventories for calendar years beyond the 2013 Baseline were not based on historically collected source activity data but were projected forward to those years based on forecasted source activity growth coupled with changes in emission factors due to already adopted federal, State, and local control measures that existed prior to the development of this Serious SIP. Effects of adopted controls within the project baseline inventories reflect measures and data collection-based emission benefits accumulated through calendar year 2016 for consistency with the earlier Moderate Area SIP, which was approved by EPA in September 2017. In inventory development, the effects of controls are included up to the year prior to the inventory projection year of interest. For consistency with the Moderate SIP 2017 approval, this means that on-going control program benefits through calendar year 2016 are part of the projected baseline.

Control or attainment analysis/demonstration inventories then include additional emission reductions from measures to be implemented under this Serious SIP or from on-going control programs for which emission benefits continued to accumulate after the end of calendar year 2016 (the “anchor point” to the Moderate SIP).

Emissions Projection Methodology

This subsection documents the development of growth factors to project source activity forward from the 2013 Baseline as well as control reductions (for programs implemented or continuing after 2013) and other adjustments.

Growth Factors

Levels of projected source activity growth can vary depending upon the type of source category. A series of growth factors were assembled from several sources for use in forecasting the activity component of 2013 baseline emissions forward to 2019 and through 2032 within the Serious Area SIP. Table 34 summarizes the growth rates applied to project activity by source sector and the sources or assumptions upon which they were based.

The Alaska Department of Transportation and Public Facilities (ADOT)/Kittelson forecasts[31] listed for a number of sectors in Table 34 were developed to support the 2045 MTP. They represent the latest projects of population, housing unit and employment growth across the Fairbanks North Star Borough. Most importantly, they include projected population growth associated with the F-35 deployment at Eielson slated to begin in 2019 (with airfield activity increasing starting in 2020). They were developed by traffic analysis zone (TAZ) and allocated to the 1.3 km modeling grid cells.

[31] Mike Aronson and Anias Malinge, Kittelson & Associates memorandum to ADOT&PF, November 22, 2017.

Table 34
Summary of Growth Rates Applied in Projected Baseline Inventories

Source Type/Group	Growth Rate Source/Assumptions	Annual Growth Rate (% per year) 2013-2019	Annual Growth Rate (% per year) 2019-2024
Point	Population growth rates from ADOT/Kittelson socio-economic forecasts for 2045 MTP (nonattainment area avg.)	0.9%	1.6%o
Area, Space Heating	Housing Unit growth rates from ADOT/Kittelson socio-economic forecasts for 2045 MTP (by grid cell)	0.9% domain average	1.7% domain average
Area, Other	Employment growth rates from ADOT/Kittelson socio-economic forecasts for 2045 MTP (nonattainment area avg.)	1.2%	1.4%
Mobile, On-Road	Population growth rates from ADOT/Kittelson socio-economic forecasts for 2045 MTP (nonattainment area avg.) Population growth rates for other counties in modeling domain from county-level forecasts developed by Alaska Department of Labor and Workforce Development	FNSB: 0.9% Denali: -0.2% SE Fbks: 0.1% Ykn-Kyk: -1.0%	FNSB: 1.6% Denali: -0.4% SE Fbks: 0.7% Ykn-Kyk: -0.8%
Mobile, Non-Road Equip.	Population growth rates from ADOT/Kittelson socio-economic forecasts for 2045 MTP for FNSB Population growth rates for other counties in modeling domain from county-level forecasts developed by Alaska Department of Labor and Workforce Development	FNSB: 0.9% Denali: -0.2% SE Fbks: 0.1% Ykn-Kyk: -1.0%	FNSB: 1.6% Denali: -0.4% SE Fbks: 0.7% Ykn-Kyk: -0.8%
Mobile, Rail	Assumed held constant at 2013 levels, based on discussions with local rail and airport personnel	Zero	Zero
Mobile, Aircraft	Assumed constant at 2013 levels for Fairbanks International Base-specific forecasts provided by Eielson and Ft. Wainwright	FAI: 1.2% Eielson: 145%[a] Wainwright: 0%	FAI: 1.2% Eielson: 71%[b] Wainwright: 0%

[a] Reflects anomalously low Eielson airfield activity in 2013, coupled with 2019 activity estimated from annual average of recorded 2015-2018 flights at Eielson.

[b] Reflects F-35 fighter jet squadron deployment starting in 2020 and phasing in through 2022.

The ADOT/Kittelson socio-economic forecasts were only available within the Fairbanks North Star Borough. As noted in Table 34, county-level population forecasts from the ADLWD[32] were utilized to represent growth for mobile sources (except rail and aircraft).

Rail activity was assumed to be constant at 2013 levels. Aircraft activity growth rates (i.e., changes in landing and takeoff (LTO) cycles) were airfield specific. Fairbanks International Airport (FAI) activity was projected to increase at a constant rate of 1.2% per year from 2013 levels based on the long-term growth rate in the FAI Master Plan.[33] For the military bases, airfield-specific growth projections by

[32] http://live.laborstats.alaska.gov/pop/projections.cfm, as of June 2018.
[33] "FAI Master Plan Project, Chapter 3 Aviation Forecasts," prepared by PDC Inc. Engineers for the Alaska Department of Transportation and Public Facilities, December 2014 (Final).

aircraft type were provided by Eielson and Fort Wainwright representatives. Fort Wainwright anticipated no long-term growth. As indicated by footnotes in Table 34, Eielson's significant increase in aircraft flights relative to 2013 was the result of two factors:

1. *Anomalously Low 2013 Activity* – A review of historical annual flight data collected by the Federal Aviation Administration (FAA)[34] from 2010 through 2018 indicated that airfield LTOs at Eielson in 2013 were well below levels recorded in other surrounding years. Annual flight counts at Eielson averaged from 2015-2018 were found to be 145% higher than 2013 flights and applied in projecting Eielson activity from 2013 to 2019, given that flights in 2013 were anomalously low.
2. *Increase from F-35 Fighter Jet Activity* – F-35 flights are scheduled to begin in 2020 and increase through 2022, then remain constant in 2023 and later years. The new F-35 operations are projected to increase total flights at Eielson by 71% from 2019 through 2024.

The historical FAA flight data were also reviewed for the other two airfields, Fairbanks International and Fort Wainwright. Their 2013 flights were found to be within 10% of the surrounding six-year averages. Thus no "anomalous year" adjustments were applied for activity at these airfields in projecting from their 2013 levels.

Existing Controls

Effects of emission controls from adopted control programs (that reduce unit emission factors for specific source categories in future years) were also accounted for in the projected baseline inventories. As noted earlier, only those control programs that reflect on-going emission reductions or were adopted under the Moderate SIP for which data-driven benefits were determined through 2016 and were included in the Projected Baseline inventories. These key control programs[35] and how they were modeled are listed below:

- *On-Road Vehicles* – Effects of the on-going federal Motor Vehicle Control Program and Tier 3 fuel standards, coupled with Alaska Ultra Low Sulfur Diesel standards were accounted for within EPA's MOVES2014b model.

- *Non-Road Vehicles and Equipment* – Effect of federal fuel and Alaska ULSD programs for non-road fuel were modeled using EPA's MOVES2014b model.

- *Wood Stove Change Out Program (2013-2016)* – Data collected by the Fairbanks North Star Borough on closed/completed transactions under the on-going Wood Stove Change Out (WSCO) Program from 2013 through 2016 were analyzed to develop estimates of emission reduction per transaction and summed over this period to account for WSCO reductions between the 2013 Baseline and the anchor point to the Moderate SIP.

- *Solid Fuel Burning Curtailment Program (2016)* – The Fairbanks Borough adopted and operated an episodic Solid Fuel Burning Appliance and Curtailment Program since winter 2015-2016. It was treated as a new measure within the Control inventories under the Moderate SIP. Under

[34] Federal Aviation Administration, Traffic Flow Management System Counts, downloaded on September 12, 2019 from https://aspm.faa.gov/tfms/sys/Airport.asp.
[35] Effects of other state and local control measures listed in the Moderate SIP for which benefits were quantified were implicitly included in the "pre-control" Projected Baseline emissions.

this Serious SIP, its benefits, reflecting the design of the program and its operation as of the end of 2016, are now accounted for as existing controls within the Projected Baseline inventories. At that time, the Curtailment Program operated with three alert stage levels. Stage 1 was voluntary. Stage 2 (35 $\mu g/m^3$) and Stage 3 (55 $\mu g/m^3$) required cessation of burning from specific types of solid fuel devices as follows:

- Stage 2 - Burning was permitted in all EPA-certified SFBAs, EPA Phase II qualified hydronic heaters with emission ratings of 2.5 g/hour or less, masonry heaters, pellet-fueled appliances cook stoves and fireplaces. Burning was prohibited from all other devices including non-EPA certified devices and waste oil devices.
- Stage 3, Ambient Temperature ≥ 15°F - Burning was prohibited in all SFBAs, masonry heaters, pellet-fueled appliances, cook stoves, fireplaces and waste oil devices.
- Stage 3, Ambient Temperature < 15°F - Burning was permitted in EPA-certified SFBAs, EPA Phase II qualified hydronic heaters with emission ratings of 2.5 g/hour or less, masonry heaters and pellet-fueled appliances. (Fireplaces were prohibited from operating under Stage 3 with temperatures < -15°F.)

Consistent with the Moderate SIP, the Curtailment Program as of the end of 2016 had an estimated compliance rate of 20%.

Other Adjustments

Beyond the application of activity growth factors and accounting for effects of existing controls from the approved Moderate SIP, four other adjustments were applied in developing Projected Baseline inventories and are summarized separately below.

Point Source Projections/Fuel Switch Effects – As explained earlier, annual emissions data from each point source facility in calendar years 2008 and 2013 were used to scale/update episodic emissions to 2013. DEC also assembled annual emissions from each facility for calendar years 2014 and 2015 and additionally for the two GVEA facilities (North Pole and Zehnder) in 2016 from their permits database to address changes in activity and emissions within the Point Source sector that could not be accounted for simply with population growth factors.

Emissions for 2015 based on annual emissions for each facility were similarly scaled from the 2008 episodic data as was done for 2013 in the Baseline inventory. The reasons for this were twofold: 1) several facilities exhibited variations in annual emissions between 2013 and 2015 that were both upward and downward and outside the range of the modest population growth factors; and 2) Flint Hills shut down its refinery operations during 2014, so reported annual emissions through 2015 were reviewed to confirm this.

Although annual emissions changes for most facilities from 2013-2015 were typically within ±10%, there were much greater swings for Flint Hills and the GVEA facilities triggered by the refinery shutdown. As noted earlier, both GVEA facilities have historically burned HAGO in their turbines, a heavy distillate fuel produced by the nearby Flint Hills Refinery. With the refinery shutdown, HAGO was no longer produced and the GVEA facilities switched their turbine fuel to lighter and cleaner distillate oil (mostly #2 distillate).

In reviewing the reported 2015 emissions data for GVEA (available by individual emission unit), it was noted that HAGO was still being burned during that year, likely reflecting on-site storage of HAGO that was still in use after 2014. As a result, reported annual 2016 emissions data for the two GVEA facilities were obtained to confirm HAGO use ended in 2015 and to represent "post-HAGO" emissions at these facilities going forward. Annual $PM_{2.5}$ emissions dropped by 96% and 65% at GVEA North Pole and GVEA Zehnder, respectively from 2013 to 2016, largely due to the switch from HAGO triggered by the Flint Hills Refinery shutdown.

Thus, for all facilities except the GVEA facilities, projected baseline emissions were based on actual 2015 emissions with population-based growth factors relative to 2015. For the GVEA facilities growth factor projections were applied to 2016 actual emissions to fully reflect post-HAGO fuel use.

Wood vs. Oil Cross-Price Elasticity – A postcard (rather than telephone) survey was conducted in 2016 to assess whether large drops in heating oil prices from 2013 to 2015 had any impact on wood use. Unlike the earlier telephone-based surveys under which a random sample was drawn from all residents in the nonattainment area, the 2016 Postcard survey targeted household respondents who had participated in the 2014 and 2015 HH surveys. Use of a postcard survey instrument enabled respondents to more thoughtfully collect and estimate wood and heating oil usage data for winter 2015-2016 space heating that could be directly compared to similar data for the same set of households as sampled in the earlier 2014 and 2015 surveys. An analysis directed by DEC[36] found that winter season residential wood use dropped 30% on average in the 2016 survey for the same set of households sampled in the 2014 and 2015 surveys, and that most of this drop could not be explained by differences in heating demand due to year-to-year variations in winter temperatures.

DEC's Staff Economist then coordinated a study by University of Alaska Fairbanks[37] that evaluated the 2016 Postcard data to determine if a cross-price elasticity could be quantified between wood use and heating oil use and prices in Fairbanks. That economic study found a median cross-price elasticity between wood and heating oil of -0.318, meaning wood use drops by 0.318% for every 1% decrease in the price of heating oil. This wood vs. cross-price elasticity was then used to estimate changes in wood vs. oil use in projected baseline inventories relative to the difference between the forecasted oil price in the projection year vs. the 2013 Baseline.

Historical heating oil prices in Fairbanks were available through calendar year 2017 from the Fairbanks Community Research Quarterly published by the Fairbanks Borough Planning Department. Heating oil prices for 2019 were forecasted from the actual 2017 price based on forecasted changes in heating oil prices for the Pacific Region between 2017 and 2019 published by the U.S. Energy Information Administration (EIA) in their 2018 Annual Energy Outlook (AEO).

For the 2019 Projected Baseline, the forecasted heating oil price in Fairbanks was $2.89 per gallon using this approach, and the 2013 price (averaged over the 2011-2015 period corresponding to the five-year

[36] T. Carlson, M. Lombardo, Sierra Research, R. Crawford, Rincon Ranch Consulting memorandum to Cindy Heil, Alaska Department of Environmental Conservation, January 17, 2017.
[37] "Estimating FNSB Home Heating Elasticities of Demand using the Proportionally-Calibrated Almost Idea Demand System (PCAIDS) Model: Postcard Data Analysis," prepared by the Alaska Department of Environmental Conservation in collaboration with the University of Alaska Fairbanks Master of Science Program in Resource and Applied Economics, December 10, 2018.

HH survey period) was \$3.60 per gallon. A projected decrease in wood use from 2013 to 2019 of 6.3% was calculated as follows based on these oil prices and the cross-price elasticity of -0.318:

$$\textit{Wood Use Change}_{2013\text{-}2019} = -0.318 \times (1 - \$2.89/\$3.60) = -6.3\%$$

Turnover of Uncertified Devices – Under the Moderate SIP it was estimated that turnover or replacement of uncertified wood burning devices with new EPA-certified devices occurred both through and separate from the WSCO Program. That estimate was based on HH survey data that was only available through the 2011 survey. Since the WSCO program began in July 2010, there was little overlap between trends established from the HH surveys (dating back to 2006 and extrapolated beyond 2011) and the available WSCO Program change outs/transactions. With the data available at the time of the Moderate SIP development, it was then estimated that there was a downward trend in uncertified wood devices (reflecting replacement with EPA-certified devices) that was separate and distinct from that attributed to the WSCO Program.

Under this Serious SIP, additional years of HH survey data (2012-2015) and WSCO Program data (through calendar year 2016) were analyzed. Over the broader 5½-year period of overlap between the HH surveys and WSCO Program activity data now available, it was found little uncertified device turnover likely occurs outside the WSCO Program. What was termed "natural turnover" of uncertified devices estimated to occur outside of the WSCO Program under the Moderate SIP was found to be difficult to separately quantify based on comparisons of HH survey trends and WSCO Program activity and is likely negligible. Therefore no "natural turnover" of uncertified devices outside the WSCO Program was assumed for the Serious SIP Projected Baseline inventories. The decrease in uncertified devices from the HH surveys through 2015 was attributed entirely to the on-going WSCO Program.

2019 Projected Baseline Emissions

Using the projected activity growth factors, emission factors representing effects of existing source control programs and other adjustments to point sources and wood usage as summarized in the preceding sub-section, a projected baseline inventory was developed for 2019, the statutorily-required attainment year for the Serious SIP.

Table 35 presents a sector-level summary of the 2019 Projected Baseline modeling and planning inventories. And Table 36 provides sector- and pollutant-specific comparisons of the relative changes in emissions between the 2013 Baseline and the 2019 Projected Baseline inventories for the Fairbanks nonattainment area.

As highlighted at the bottom of Table 36, total $PM_{2.5}$ emissions under the 2019 Projected Baseline are 18% lower across the nonattainment area than in 2013. This is largely driven by effects of the WSCO and Curtailment programs through 2016 and the oil price driven wood use shift in the space heating sector, coupled with the effects of the shift from HAGO fuel within the point source sector.

Except for SO_2, the gaseous pollutants show similar overall reductions, driven by factors that span several sectors including federal mobile source controls and wood-burning reductions. The increase in SO_2 emissions is largely due to the change in aircraft flights at Eielson AFB between 2013 and 2019.

Table 35
2019 Projected Baseline Episode Average Daily Emissions (tons/day) by Source Sector

Source Sector	$PM_{2.5}$	NOx	SO_2	VOC	NH_3
Point Sources	0.83	10.63	7.13	0.09	0.020
Area, Space Heating	2.24	2.44	3.85	8.62	0.132
Area, Space Heat, Wood	2.08	0.40	0.12	8.40	0.086
Area, Space Heat, Oil	0.07	1.83	3.61	0.10	0.004
Area, Space Heat, Coal	0.08	0.05	0.09	0.11	0.014
Area, Space Heat, Other	0.01	0.17	0.02	0.01	0.029
Area, Other	0.20	0.25	0.02	2.35	0.049
On-Road Mobile	0.14	1.83	0.01	2.86	0.038
Non-Road Mobile	0.24	1.21	10.62	0.41	0.000
TOTALS	**3.67**	**16.36**	**21.62**	**14.33**	**0.238**

Table 36
Relative Change (%) in Episode Average Daily Emissions (tons/day) by Source Sector, 2019 Projected Baseline vs. 2013 Baseline

Source Sector	$PM_{2.5}$	NOx	SO_2	VOC	NH_3
Point Sources	-32%	+2%	-1%	-62%	-62%
Area, Space Heating	-13%	+5%	+6%	-9%	-3%
Area, Space Heat, Wood	-14%	-2%	+47%	-9%	-6%
Area, Space Heat, Oil	+6%	+6%	+6%	+6%	+6%
Area, Space Heat, Coal	-6%	+3%	-4%	+3%	+3%
Area, Space Heat, Other	+1%	+3%	-4%	+4%	+4%
Area, Other	-7%	-86%	-53%	+3%	+7%
On-Road Mobile	-46%	-46%	-68%	-30%	-30%
Non-Road Mobile	+62%	+41%	+74%	-0%	+0%
TOTALS	**-18%**	**-13%**	**+27%**	**-13%**	**-17%**

2019 Control Benefits Analysis

The second and final stage of estimating emissions in 2019 consisted of applying adjustments to the Projected Baseline inventories to reflect additional incremental effects of State and local control measures not included in those baselines that reflect emission reductions through the end of calendar year 2018. These final future year inventories are called the Control inventories and are discussed below.

Emission reductions for additional control measures beyond those reflected in the Moderate SIP were quantified for two on-going local programs for which data were available: 1) the Wood Stove Change Out Program; and 2) the Solid-Fuel Burning Appliance Curtailment Program. Emission benefit calculations from each of the local programs are described separately below.

Wood Stove Change Out Program (2017-2018) – As noted earlier, since June 2010, the Fairbanks North Star Borough has operated a program within the nonattainment area designed to provide incentives for the replacement of older, higher-polluting residential wood-burning devices with new cleaner devices, or removal of the old devices. The design of the WSCO Program has evolved over time, but these changes have generally consisted of both increasing the financial incentives as well as expanding the types of solid fuel burning appliances (SFBAs) or devices that are eligible to participate in the program.

Under its current design, the WSCO program provides financial incentives as follows:

REIMBURSEMENT OPTIONS

- **Replace Other SFBA with an:**
  - appliance designed to use natural gas or propane (up to $10,000)*****
  - appliance designed to use home heating oil (excluding waste/used oil), emergency power system (i.e. generator), hot water district heat, or electricity (up to $6,000)*
  - EPA Certified pellet burning appliance with an emissions rate less than or equal to 2.0 grams/hour (up to $5,000)
  - EPA certified **CATALYTIC** SFBA with an emissions rating of 2.0 grams/hr or less, or if an EPA certified SFBA with an emissions rate of 2.5 grams/hour or greater is replaced with another EPA certified SFBA, the emission rate of the new appliance must be 2.0 grams/hour or less **AND** 50% or less than the replaced appliance (up to $4,000)
- **Replace Hydronic heater with an:**
  - appliance designed to use natural gas, propane, hot water district heat, or electricity* (up to $14,000)
  - appliance designed to use home heating oil* (excluding waste/used oil) (up to $12,000)
  - EPA certified **CATALYTIC** wood stove or an EPA certified pellet stove with an emissions rating of 2.0 grams/hr or less, or an EPA phase II certified pellet burning hydronic heater with an emissions rating of 0.1 lbs/million BTU or less, or emergency power system (i.e. generator)* (up to $10,000)
- **Removal of a:**
  - SFBA -- $2,000 cash payment*****
  - hydronic heater -- $5,000 cash payment*****
- **Repair** Catalytic converter or Other Emissions-Reducing Components (up to $750)

Incremental benefits from the WSCO program beyond its reductions accounted for in the Moderate SIP reflect change outs that occurred in calendar years 2017 and 2018. WSCO transaction data was obtained from the Borough through calendar year 2018. For each application under the program, the Borough records the following elements:

- Applicant information (including address);
- Program/transaction type (replacement, removal, repair);
- Old device type (e.g., fireplace, wood stove, OWB, etc.);
- Old device certification (uncertified or EPA-certified);
- Old device model (and certified emission rate for certified devices);
- New device type (which can include conversion to heating oil or natural gas devices);
- New device model;
- New device certification (where applicable);

- New device emission rate (where applicable); and
- Application status (pending or closed/completed).

For each completed transaction, $PM_{2.5}$ and SO_2 emission benefits were calculated using the information listed above. Emission factors (in lb/mmBTU) by device/technology/certification status used in the baseline inventory were used to represent emissions for old devices being replaced, removed or repaired.

For wood-to-wood device replacements, emission factors of new devices were estimated from regression-based translations of certification emission rates (gram/hr) to emission factors (lb/mmBTU) developed from EPA certified wood burning device database. For solid fuel to oil/natural gas conversion replacements, inventory-based heating oil or natural gas emission factors were applied to represent "after change out" emissions from the new device.

For device removal transactions, it was assumed that the heating energy associated with removing the old wood device would be replaced with equivalent heating energy of a heating oil device.

For device repair transactions an average 10% emission reduction was assumed. (There were only a modest number of repair transactions, but some included repair of the catalyst and chimney which could provide measurable reductions or efficiency improvements).

Finally, for all device replacement or removal transactions effects of differences in old vs. new (or shifted) device heating efficiency were also accounted for.

The per-transaction emission reductions (calculated on a tons per episode day basis) were then tabulated by calendar year (based on close out date).

Table 37 presents a summary of the number and types of completed/verified WSCO Program transactions in calendar years 2017-2018 and their calculated $PM_{2.5}$ and SO_2 emission reductions (in tons/episode day) based on the methods described above. As highlighted at the bottom of Table 37, direct $PM_{2.5}$ reductions from the WSCO program in 2017 and 2018 totaled just over 0.2 tons/episode day. SO_2 emissions nominally increase due to device removals and conversions to heating oil, which has higher per unit energy sulfur content than wood.

Table 37
Wood Stove Change Out Program Transactions and Emission Reductions, 2017-2018

Transaction Type	Completed Transactions	Reductions (tons/episode day)	
		$PM_{2.5}$	SO_2
SFBA Replacement, uncertified to certified	112	0.0339	0.0004
SFBA Replacement, certified to 2 gram/hour certified	3	0.0011	0.0000
Conversion (solid fuel to oil or natural gas)	272	0.1637	-0.0074
Other (removal or repair)	23	0.0105	-0.0004
TOTALS	**410**	**0.2039**	**-0.0074**

<u>Compliance Rate Measurement</u> - Compliance behavior depends on many factors, including frequency of burn bans (the more frequent, the greater the fatigue and decline in compliance), income and the cost of alternatives, ambient temperature (as arctic temperatures drop below -20° F motivation for additional heating increases), change as the wood burning season progresses (initial compliance enthusiasm will degrade as the number of winter days increase and the cost of alternatives and inconvenience accumulate), etc. Thus, measurement for limited periods of time is unlikely to capture changes in behavior that occur during the course of a winter. Another factor effecting compliance is the approach taken to enforcement which may include: field activity (i.e.,. presence of staff in the field) , levels of engagement before penalties are assessed and publicized, magnitude of penalties assessed, escalation of penalties for repeat offenders, etc.

The results of field observations collected during 4 Alert days (Jan 11, 20 and Feb 4 and 10) in North Pole in 2018 are presented in Table 38. They show two different estimates of compliance. The total value based on 301 observations was calculated to be 81.1%. A lower value based on an average of unique observations (same homes surveyed multiple times) is lower at 69.23%.

Table 38. Compliance Rate Observations

North Pole Totals (winter 2018)	
Number of observations made:	301
Number observed not burning:	236
Number observed burning:	55
Number of invalid observations:	10
Compliance Rate:	***81.10%***
Number of unique addresses observed:	125
Number of unique addresses observed burning once:	36
Number of unique addresses observed never burning:	81
Number of unique addresses w/ invalid data:	8
Compliance Rate:	***69.23%***

Table 39 documents how compliance changes as number to times a home was observed. It shows that the individual home compliance rate declines as behavior is not consistent.

Table 39. Compliance Rate vs Number of Observations

Totals by Number of Times a Unique Address was Observed						
		# of observations	Invalid Data	# of useable observations	# observed burning	***Compliance Rate***
# of times a unique address was observed	1	34	7	27	3	***88.89%***
	2	27		27	7	***74.07%***
	3	44		44	16	***63.64%***
	4	19	1	18	9	***50.00%***
	5	1		1	1	***0.00%***

While these results are based on biased sample (wood stove change out participants), they provide the basis for considering a program to seasonally assess compliance with Alerts.

To help guide the design of a program a spreadsheet was prepared to assess how expected compliance rate and uncertainty vary with sample size (based on the assumption that compliance is a 50/50 proposition). It showed that surveying 100 wood burners is enough to estimate the average compliance rate to within a 95% confidence Interval of +/- 10% of the expected value. Another consideration is the effect of sample size on the precision of the estimate. Figure 9 displays how survey precision changes with expected compliance for a 100 wood burner sample. It shows that uncertainty peaks as compliance approaches 50% and falls off as behavior becomes more certain in one direction or the other.

Figure 9. Survey Precision

This information was used to prepare the compliance rate survey task outlined in the grant application.

<u>Curtailment Program (end of 2018)</u> – In 2017, the Solid-Fuel Burning Appliance Curtailment Program was redesigned to a two alert stage program at 25 µg/m^3 and 35 µg/m^3 for Stages 1 and 2, respectively without a voluntary alert stage. In addition, the temperature threshold that earlier allowed some uncertified devices to operate at the highest alert stage was removed. And the burn restrictions under the new Stage 1 and Stage 2 thresholds were tightened to allow only certified devices to operate under Stage 1 and no solid fuel devices to operate under Stage 2 except those NOASH (No Other Adequate Source of Heat) households in the Fairbanks and North Pole Air Quality Control Zones (AQCZs) within the nonattainment area.

In addition, based on on-going outreach and additional and more efficient enforcement procedures, the Curtailment Program compliance rate was estimated to increase to 30% (from 20% compliance estimated under the Moderate SIP).

Benefits of the "revised" Curtailment Program as it existed/operated at the end of 2018 were calculated in a manner similar to that applied under the Moderate SIP. Reduction fractions were applied to Projected Baseline space heating emissions by device/technology type/fuel type for the inventory strata listed earlier in Table 7. These reduction fractions accounted for the fraction of devices (by stratum) operating under each curtailment stage, given the estimated compliance rate and the NOASH households fraction. The NOASH fraction within the nonattainment area was estimated from the 2011-2015 HH survey data at 4%. This fraction is higher than the annual NOASH waiver applications received by the Borough (which currently amounts to less than 1% of nonattainment area households.) The higher NOASH rate was assumed for consistency with other elements of the emission inventory, which has a conservative or understated impact on resulting emission benefits from the Curtailment Program.

In addition to accounting for emission reductions associated with curtailment of solid fuel burning devices, the analysis also accounts for emissions from "shifted" energy use under each curtailment stage to heating oil and addresses efficiency differences between the solid fuel and heating oil devices.

Finally, the emission reductions are discounted to account for the fraction of households within the nonattainment area that are outside the Fairbanks and North Pole AQCZs within which the Curtailment Program applies. The fraction of nonattainment area emissions occurring within the nonattainment area, but outside AQCZ was estimated at 12.4% and was determined from a GIS-based analysis of block-level occupied household data from the 2010 Census.

Table 38 summarizes the resulting incremental emission benefits associated with revisions to the Curtailment Program between 2016 and 2018. For equivalency, the emission benefits are shown at the 35 $\mu g/m^3$ alert level common to both versions of the program.

It is important to note that in applying the benefits of the curtailment program within the downstream air quality modeling, benefits are separately calculated at each alert stage by SCC code. The incremental benefits shown above in Table 40 are higher than the average across all modeling episode days, some of which do not exceed the 35 $\mu g/m^3$ alert threshold.

Table 40
Incremental Curtailment Program Emission Reductions (2018 vs. 2016)
at 35 $\mu g/m^3$ Alert Level

Program State	Reductions (tons/day)	
	$PM_{2.5}$	SO_2
2018 Curtailment Program, Stage 2 (35 $\mu g/m^3$), 30% Compliance	0.363	-0.062
2016 Curtailment Program, Stage 2 (35 $\mu g/m^3$), 20% Compliance	0.125	-0.009
Incremental Reductions: 2018 vs. 2016 Program, 35 $\mu g/m^3$ **Alert Level**	**0.238**	**-0.053**

2019 Control Emissions

Based on the control measure analysis described in the preceding sub-section the 2019 Control Inventory was developed to evaluate attainment as statutorily required by 2019. As noted earlier, it represents incremental effects of control measures beyond that taken credit for under the Moderate SIP.

Source Sector Summary

Table 41 presents a similar sector-level summary of the 2019 Control modeling and planning inventories. And Table 42 provides sector- and pollutant-specific comparisons of the relative changes in emissions between the 2019 Projected Baseline and the 2019 Control inventories (both modeling and planning versions).

Table 41
2019 Control Episode Average Daily Emissions (tons/day) by Source Sector

Source Sector	$PM_{2.5}$	NOx	SO_2	VOC	NH_3
Point Sources	0.83	10.63	7.13	0.09	0.020
Area, Space Heating	2.11	2.44	3.87	8.62	0.132
Area, Space Heat, Wood	1.95	0.40	0.14	8.40	0.086
Area, Space Heat, Oil	0.07	1.83	3.61	0.10	0.004
Area, Space Heat, Coal	0.08	0.05	0.09	0.11	0.014
Area, Space Heat, Other	0.01	0.17	0.02	0.01	0.029
Area, Other	0.20	0.25	0.02	2.35	0.049
On-Road Mobile	0.14	1.83	0.01	2.86	0.038
Non-Road Mobile	0.24	1.21	10.62	0.41	0.000
TOTALS	**3.53**	**16.36**	**21.64**	**14.33**	**0.238**

Table 42
Relative Change (%) in Episode Average Daily Emissions (tons/day) by Source Sector, 2019 Control vs. 2019 Projected Baseline

Source Sector	$PM_{2.5}$	NOx	SO_2	VOC	NH_3
Point Sources	+0%	+0%	+0%	+0%	+0%
Area, Space Heating	-6%	+0%	+0%	+0%	+0%
Area, Space Heat, Wood	-6%	+0%	+18%	+0%	+0%
Area, Space Heat, Oil	+0%	+0%	+0%	+0%	+0%
Area, Space Heat, Coal	-5%	+0%	-4%	+0%	+0%
Area, Space Heat, Other	-1%	+0%	-1%	+0%	+0%
Area, Other	+0%	+0%	+0%	+0%	+0%
On-Road Mobile	+0%	+0%	+0%	+0%	+0%
Non-Road Mobile	+0%	+0%	+0%	+0%	+0%
TOTALS	**-4%**	**+0%**	**+0%**	**+0%**	**+0%**

The relative reductions shown in Table 42 are for $PM_{2.5}$ and SO_2 only and are restricted to the space heating sector within which the incremental control measures apply.

It is also noted that the control reductions reflected in Table 41 and Table 42 are lower than shown earlier for the WSCO Program and the Curtailment Program in Table 39 and Table 40 for two reasons. First, Curtailment Program benefits averaged across all modeling episode days are “diluted” from those shown which apply only at the 35 µg/m^3 alert threshold. (The modeling episodes include “spin-up” spin-down” days during which measured ambient concentrations do not exceed this threshold.) Second, the overlap of the two measures are addressed in Table 41 and Table 42, but are not reflected in individual measure benefits reported in Table 39 and Table 40.

Detailed SCC-Level Emissions

Finally, a complete set of emissions by individual Source Classification Code (SCC) for the 2019 Control inventory of the Fairbanks $PM_{2.5}$ nonattainment area is presented in Table 43. Within each source sector, emissions are further broken down by detailed source category (i.e., SCC). In addition, for source categories for which separate condensable and filterable $PM_{2.5}$ emission components were available from the Serious SIP, these component emissions are also shown. Sector subtotal and inventory grand total emissions are shown in highlighted rows in Table 43.

Table 43
2019 Control Inventory Episode Average Daily Emissions (tons/day) by Source Sector and Source Classification Code (SCC)

Source Sector	SCC Code	SCC Description	$PM_{2.5}$ Total	PM_{25} Cond.	PM_{25} Filt.	NOx	SO_2	VOC	NH_3
Point	All		**0.834**	**0.706**	**0.128**	**10.634**	**7.130**	**0.088**	**0.020**
Point	10100224	External Combustion Boilers / Electric Generation / Subbituminous Coal / Boiler, Spreader Stoker	0.183	0.174	0.009	1.619	1.932	0.008	0.000
Point	10100225	External Combustion Boilers / Electric Generation / Subbituminous Coal / Boiler, Traveling Grate (Overfeed) Stoker	0.071	0.067	0.004	0.877	0.528	0.008	0.000
Point	10200229	External Combustion Boilers / Industrial / Subbituminous Coal / Cogeneration	0.402	0.353	0.049	2.580	2.528	0.068	0.000
Point	10300501	External Combustion Boilers / Commercial/Institutional / Distillate Oil - Grades 1 and 2 / Boiler	0.008	0.005	0.003	0.078	0.161	0.002	0.007
Point	10500105	External Combustion / Space Heaters / Industrial / Distillate Oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Point	20100109	Internal Combustion Engines / Electric Generation / Distillate Oil (Diesel) / Turbine: Exhaust	0.157	0.098	0.059	3.878	1.973	0.001	0.009
Point	20100907	Internal Combustion Engines / Electric Generation / Kerosene/Naphtha (Jet Fuel) / Reciprocating: Exhaust	0.000	0.000	0.000	0.006	0.000	0.000	0.000
Point	20100909	Internal Combustion Engines / Electric Generation / Kerosene/Naphtha (Jet Fuel) / Turbine: Exhaust	0.013	0.008	0.005	1.597	0.008	0.001	0.003
Point	30190001	Industrial Processes / Chemical Manufacturing / Fuel Fired Equipment / Process Heater: Distillate Oil (No. 2)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Area, Space Heat	All		**2.106**			**2.443**	**3.866**	**8.625**	**0.132**
Area, Space Heat	2102012000	Stationary Source Fuel Combustion / Industrial / Waste oil / Total	0.002			0.024	0.016	0.001	0.000
Area, Space Heat	2103002000	Stationary Source Fuel Combustion / Commercial/Institutional / Bituminous/Subbituminous Coal / Total: All Boiler Types	0.000			0.000	0.000	0.000	0.000
Area, Space Heat	2103004001	Stationary Source Fuel Combustion / Commercial/Institutional / Distillate Oil / Boilers	0.015			0.588	0.416	0.023	0.001
Area, Space Heat	2103006000	Stationary Source Fuel Combustion / Commercial/Institutional / Natural Gas / Total: Boilers and IC Engines	0.010			0.133	0.001	0.007	0.027
Area, Space Heat	2103008000	Stationary Source Fuel Combustion / Commercial/Institutional / Wood / Total: All Boiler Types	0.000			0.000	0.000	0.001	0.000
Area, Space Heat	2104002000	Stationary Source Fuel Combustion / Residential / Bituminous/Subbituminous Coal / Total: All Combustor Types	0.076			0.052	0.091	0.109	0.014
Area, Space Heat	2104004000	Stationary Source Fuel Combustion / Residential / Distillate Oil / Total: All Combustor Types	0.051			1.241	3.198	0.079	0.003
Area, Space Heat	2104006010	Stationary Source Fuel Combustion / Residential / Natural Gas / Residential Furnaces	0.001	0.001	0.000	0.011	0.000	0.001	0.002
Area, Space Heat	2104008100	Stationary Source Fuel Combustion / Residential / Wood / Fireplace: general	0.537			0.046	0.007	4.085	0.032
Area, Space Heat	2104008210	Stationary Source Fuel Combustion / Residential / Wood / Woodstove: fireplace inserts; non-EPA certified	0.041			0.004	0.001	0.083	0.003

Source Sector	SCC Code	SCC Description	$PM_{2.5}$ Total	PM_{25} Cond.	PM_{25} Filt.	NOx	SO_2	VOC	NH_3
Area, Space Heat	2104008220	Stationary Source Fuel Combustion / Residential / Wood / Woodstove: fireplace inserts; EPA certified; non-catalytic	0.034			0.007	0.003	0.040	0.003
Area, Space Heat	2104008230	Stationary Source Fuel Combustion / Residential / Wood / Woodstove: fireplace inserts; EPA certified; catalytic	0.022			0.004	0.002	0.030	0.002
Area, Space Heat	2104008310	Stationary Source Fuel Combustion / Residential / Wood / Woodstove: freestanding, non-EPA certified	0.327			0.046	0.022	1.693	0.013
Area, Space Heat	2104008320	Stationary Source Fuel Combustion / Residential / Wood / Woodstove: freestanding, EPA certified, non-catalytic	0.449			0.108	0.051	0.807	0.017
Area, Space Heat	2104008330	Stationary Source Fuel Combustion / Residential / Wood / Woodstove: freestanding, EPA certified, catalytic	0.300			0.065	0.032	0.608	0.010
Area, Space Heat	2104008410	Stationary Source Fuel Combustion / Residential / Wood / Woodstove: pellet-fired, non-EPA certified (freestanding or FP insert)	0.011			0.018	0.003	0.010	0.000
Area, Space Heat	2104008420	Stationary Source Fuel Combustion / Residential / Wood / Woodstove: pellet-fired, EPA certified (freestanding or FP insert)	0.037			0.060	0.011	0.034	0.001
Area, Space Heat	2104008610	Stationary Source Fuel Combustion / Residential / Wood / Hydronic heater: outdoor	0.194			0.036	0.014	1.013	0.005
Area, Other	All		**0.205**			**0.246**	**0.016**	**2.347**	**0.049**
Area, Other	10200502	External Combustion Boilers / Industrial / Distillate Oil / 10-100 Million BTU/hr **	0.005	0.004	0.001	0.003	0.007	0.000	0.000
Area, Other	10300208	External Combustion Boilers / Commercial/Institutional / Bituminous Coal / Underfeed Stoker	0.015	0.003	0.012	0.010	0.000	0.022	0.000
Area, Other	20200402	Internal Combustion Engines / Industrial / Dual Fuel (Oil/Gas) / Large Bore Engine	0.000	0.000	0.000	0.027	0.000	0.013	0.000
Area, Other	30600106	Industrial Processes / Petroleum Industry / Process Heaters / Process Gas-fired	0.007			0.045	0.001	0.029	0.000
Area, Other	2102004000	Stationary Source Fuel Combustion / Industrial / Distillate Oil / Total: Boilers and IC Engines	0.015			0.161	0.009	0.081	0.000
Area, Other	2102006000	Stationary Source Fuel Combustion / Industrial / Natural Gas / Total: Boilers and IC Engines	0.006			0.000	0.000	0.089	0.049
Area, Other	2302002100	Industrial Processes / Food and Kindred Products: SIC 20 / Commercial Cooking - Charbroiling / Conveyorized Charbroiling	0.006			0.000	0.000	0.002	0.000
Area, Other	2302002200	Industrial Processes / Food and Kindred Products: SIC 20 / Commercial Cooking - Charbroiling / Under-fired Charbroiling	0.040			0.000	0.000	0.006	0.000
Area, Other	2302003000	Industrial Processes / Food and Kindred Products: SIC 20 / Commercial Cooking - Frying / Deep Fat Frying	0.000			0.000	0.000	0.001	0.000
Area, Other	2302003100	Industrial Processes / Food and Kindred Products: SIC 20 / Commercial Cooking - Frying / Flat Griddle Frying	0.008			0.000	0.000	0.001	0.000
Area, Other	2302003200	Industrial Processes / Food and Kindred Products: SIC 20 / Commercial Cooking - Frying / Clamshell Griddle Frying	0.001			0.000	0.000	0.000	0.000
Area, Other	2311020000	Industrial Processes / Construction: SIC 15 - 17 / Industrial/Commercial/Institutional / Total	0.102			0.000	0.000	0.000	0.000
Area, Other	2401008000	Solvent Utilization / Surface Coating / Traffic Markings / Total: All Solvent Types	0.000			0.000	0.000	0.066	0.000

Source Sector	SCC Code	SCC Description	$PM_{2.5}$ Total	PM_{25} Cond.	PM_{25} Filt.	NOx	SO_2	VOC	NH_3
Area, Other	2401055000	Solvent Utilization / Surface Coating / Machinery and Equipment: SIC 35 / Total: All Solvent Types	0.000			0.000	0.000	0.003	0.000
Area, Other	2401090000	Solvent Utilization / Surface Coating / Miscellaneous Manufacturing / Total: All Solvent Types	0.000			0.000	0.000	0.007	0.000
Area, Other	2415000000	Solvent Utilization / Degreasing / All Processes/All Industries / Total: All Solvent Types	0.000			0.000	0.000	0.150	0.000
Area, Other	2425000000	Solvent Utilization / Graphic Arts / All Processes / Total: All Solvent Types	0.000			0.000	0.000	0.112	0.000
Area, Other	2460100000	Solvent Utilization / Miscellaneous Non-industrial: Consumer and Commercial / All Personal Care Products / Total: All Solvent Types	0.000			0.000	0.000	0.305	0.000
Area, Other	2460200000	Solvent Utilization / Miscellaneous Non-industrial: Consumer and Commercial / All Household Products / Total: All Solvent Types	0.000			0.000	0.000	0.335	0.000
Area, Other	2460400000	Solvent Utilization / Miscellaneous Non-industrial: Consumer and Commercial / All Automotive Aftermarket Products / Total: All Solvent Types	0.000			0.000	0.000	0.207	0.000
Area, Other	2460500000	Solvent Utilization / Miscellaneous Non-industrial: Consumer and Commercial / All Coatings and Related Products / Total: All Solvent Types	0.000			0.000	0.000	0.145	0.000
Area, Other	2460600000	Solvent Utilization / Miscellaneous Non-industrial: Consumer and Commercial / All Adhesives and Sealants / Total: All Solvent Types	0.000			0.000	0.000	0.087	0.000
Area, Other	2460800000	Solvent Utilization / Miscellaneous Non-industrial: Consumer and Commercial / All FIFRA Related Products / Total: All Solvent Types	0.000			0.000	0.000	0.271	0.000
Area, Other	2460900000	Solvent Utilization / Miscellaneous Non-industrial: Consumer and Commercial / Miscellaneous Products (Not Otherwise Covered) / Total: All Solvent Types	0.000			0.000	0.000	0.011	0.000
Area, Other	2461022000	Solvent Utilization / Miscellaneous Non-industrial: Commercial / Emulsified Asphalt / Total: All Solvent Types	0.000			0.000	0.000	0.029	0.000
Area, Other	2501011011	Storage and Transport / Petroleum and Petroleum Product Storage / Residential Portable Gas Cans / Permeation	0.000			0.000	0.000	0.008	0.000
Area, Other	2501011012	Storage and Transport / Petroleum and Petroleum Product Storage / Residential Portable Gas Cans / Evaporation (includes Diurnal losses)	0.000			0.000	0.000	0.008	0.000
Area, Other	2501011013	Storage and Transport / Petroleum and Petroleum Product Storage / Residential Portable Gas Cans / Spillage During Transport	0.000			0.000	0.000	0.007	0.000
Area, Other	2501011014	Storage and Transport / Petroleum and Petroleum Product Storage / Residential Portable Gas Cans / Refilling at the Pump - Vapor Displacement	0.000			0.000	0.000	0.001	0.000
Area, Other	2501012013	Storage and Transport / Petroleum and Petroleum Product Storage / Commercial Portable Gas Cans / Spillage During Transport	0.000			0.000	0.000	0.009	0.000
Area, Other	2501012014	Storage and Transport / Petroleum and Petroleum Product Storage / Commercial Portable Gas Cans / Refilling at the Pump - Vapor Displacement	0.000			0.000	0.000	0.004	0.000
Area, Other	2501050120	Storage and Transport / Petroleum and Petroleum Product Storage / Bulk Terminals: All Evaporative Losses / Gasoline	0.000			0.000	0.000	0.003	0.000
Area, Other	2501060051	Storage and Transport / Petroleum and Petroleum Product Storage / Gasoline Service Stations / Stage 1: Submerged Filling	0.000			0.000	0.000	0.090	0.000

Source Sector	SCC Code	SCC Description	$PM_{2.5}$ Total	PM_{25} Cond.	PM_{25} Filt.	NOx	SO_2	VOC	NH_3
Area, Other	2501060052	Storage and Transport / Petroleum and Petroleum Product Storage / Gasoline Service Stations / Stage 1: Splash Filling	0.000			0.000	0.000	0.026	0.000
Area, Other	2501060053	Storage and Transport / Petroleum and Petroleum Product Storage / Gasoline Service Stations / Stage 1: Balanced Submerged Filling	0.000			0.000	0.000	0.039	0.000
Area, Other	2501060201	Storage and Transport / Petroleum and Petroleum Product Storage / Gasoline Service Stations / Underground Tank: Breathing and Emptying	0.000			0.000	0.000	0.026	0.000
Area, Other	2501080050	Storage and Transport / Petroleum and Petroleum Product Storage / Airports : Aviation Gasoline / Stage 1: Total	0.000			0.000	0.000	0.117	0.000
Area, Other	2501080100	Storage and Transport / Petroleum and Petroleum Product Storage / Airports : Aviation Gasoline / Stage 2: Total	0.000			0.000	0.000	0.012	0.000
Area, Other	2505030120	Storage and Transport / Petroleum and Petroleum Product Transport / Truck / Gasoline	0.000			0.000	0.000	0.002	0.000
Area, Other	2505040120	Storage and Transport / Petroleum and Petroleum Product Transport / Pipeline / Gasoline	0.000			0.000	0.000	0.021	0.000
Onroad Mobile	All		**0.144**			**1.828**	**0.006**	**2.862**	**0.038**
Onroad Mobile	2201210102	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Car / Off-Network / Start Exhaust	0.018			0.139	0.000	0.788	0.000
Onroad Mobile	2201210111	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Car / Off-Network / Evaporative Permeation	0.000			0.000	0.000	0.000	0.000
Onroad Mobile	2201210112	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Car / Off-Network / Evaporative Fuel Vapor Venting	0.000			0.000	0.000	0.002	0.000
Onroad Mobile	2201210113	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Car / Off-Network / Evaporative Fuel Leaks	0.000			0.000	0.000	0.015	0.000
Onroad Mobile	2201210116	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Car / Off-Network / Crankcase Start Exhaust	0.000			0.000	0.000	0.010	0.000
Onroad Mobile	2201210118	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Car / Off-Network / Refueling Displacement Vapor Loss	0.000			0.000	0.000	0.000	0.000
Onroad Mobile	2201210119	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Car / Off-Network / Refueling Spillage Loss	0.000			0.000	0.000	0.001	0.000
Onroad Mobile	2201210201	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Car / Rural Restricted Access / Running Exhaust	0.001			0.016	0.000	0.002	0.002
Onroad Mobile	2201210213	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Car / Rural Restricted Access / Evaporative Fuel Leaks	0.000			0.000	0.000	0.001	0.000
Onroad Mobile	2201210219	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Car / Rural Restricted Access / Refueling Spillage Loss	0.000			0.000	0.000	0.000	0.000
Onroad Mobile	2201210301	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Car / Rural Unrestricted Access / Running Exhaust	0.001			0.024	0.000	0.003	0.003
Onroad Mobile	2201210312	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Car / Rural Unrestricted Access / Evaporative Fuel Vapor Venting	0.000			0.000	0.000	0.001	0.000

Source Sector	SCC Code	SCC Description	$PM_{2.5}$ Total	PM_{25} Cond.	PM_{25} Filt.	NOx	SO_2	VOC	NH_3
Onroad Mobile	2201210313	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Car / Rural Unrestricted Access / Evaporative Fuel Leaks	0.000			0.000	0.000	0.001	0.000
Onroad Mobile	2201210318	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Car / Rural Unrestricted Access / Refueling Displacement Vapor Loss	0.000			0.000	0.000	0.000	0.000
Onroad Mobile	2201210319	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Car / Rural Unrestricted Access / Refueling Spillage Loss	0.000			0.000	0.000	0.001	0.000
Onroad Mobile	2201210401	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Car / Urban Restricted Access / Running Exhaust	0.001			0.013	0.000	0.002	0.001
Onroad Mobile	2201210413	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Car / Urban Restricted Access / Evaporative Fuel Leaks	0.000			0.000	0.000	0.000	0.000
Onroad Mobile	2201210501	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Car / Urban Unrestricted Access / Running Exhaust	0.002			0.037	0.001	0.006	0.004
Onroad Mobile	2201210509	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Car / Urban Unrestricted Access / Brakewear	0.001			0.000	0.000	0.000	0.000
Onroad Mobile	2201210512	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Car / Urban Unrestricted Access / Evaporative Fuel Vapor Venting	0.000			0.000	0.000	0.001	0.000
Onroad Mobile	2201210513	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Car / Urban Unrestricted Access / Evaporative Fuel Leaks	0.000			0.000	0.000	0.003	0.000
Onroad Mobile	2201210518	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Car / Urban Unrestricted Access / Refueling Displacement Vapor Loss	0.000			0.000	0.000	0.001	0.000
Onroad Mobile	2201210519	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Car / Urban Unrestricted Access / Refueling Spillage Loss	0.000			0.000	0.000	0.001	0.000
Onroad Mobile	2201310102	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Off-Network / Start Exhaust	0.050			0.314	0.001	1.547	0.000
Onroad Mobile	2201310111	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Off-Network / Evaporative Permeation	0.000			0.000	0.000	0.001	0.000
Onroad Mobile	2201310112	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Off-Network / Evaporative Fuel Vapor Venting	0.000			0.000	0.000	0.002	0.000
Onroad Mobile	2201310113	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Off-Network / Evaporative Fuel Leaks	0.000			0.000	0.000	0.028	0.000
Onroad Mobile	2201310116	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Off-Network / Crankcase Start Exhaust	0.000			0.000	0.000	0.020	0.000
Onroad Mobile	2201310118	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Off-Network / Refueling Displacement Vapor Loss	0.000			0.000	0.000	0.002	0.000
Onroad Mobile	2201310119	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Off-Network / Refueling Spillage Loss	0.000			0.000	0.000	0.002	0.000
Onroad Mobile	2201310201	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Rural Restricted Access / Running Exhaust	0.003			0.069	0.001	0.009	0.004

Source Sector	SCC Code	SCC Description	$PM_{2.5}$ Total	PM_{25} Cond.	PM_{25} Filt.	NOx	SO_2	VOC	NH_3
Onroad Mobile	2201310212	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Rural Restricted Access / Evaporative Fuel Vapor Venting	0.000			0.000	0.000	0.001	0.000
Onroad Mobile	2201310213	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Rural Restricted Access / Evaporative Fuel Leaks	0.000			0.000	0.000	0.001	0.000
Onroad Mobile	2201310218	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Rural Restricted Access / Refueling Displacement Vapor Loss	0.000			0.000	0.000	0.002	0.000
Onroad Mobile	2201310219	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Rural Restricted Access / Refueling Spillage Loss	0.000			0.000	0.000	0.001	0.000
Onroad Mobile	2201310301	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Rural Unrestricted Access / Running Exhaust	0.003			0.094	0.001	0.013	0.006
Onroad Mobile	2201310309	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Rural Unrestricted Access / Brakewear	0.001			0.000	0.000	0.000	0.000
Onroad Mobile	2201310310	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Rural Unrestricted Access / Tirewear	0.001			0.000	0.000	0.000	0.000
Onroad Mobile	2201310312	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Rural Unrestricted Access / Evaporative Fuel Vapor Venting	0.000			0.000	0.000	0.002	0.000
Onroad Mobile	2201310313	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Rural Unrestricted Access / Evaporative Fuel Leaks	0.000			0.000	0.000	0.003	0.000
Onroad Mobile	2201310318	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Rural Unrestricted Access / Refueling Displacement Vapor Loss	0.000			0.000	0.000	0.003	0.000
Onroad Mobile	2201310319	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Rural Unrestricted Access / Refueling Spillage Loss	0.000			0.000	0.000	0.003	0.000
Onroad Mobile	2201310401	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Urban Restricted Access / Running Exhaust	0.003			0.055	0.000	0.007	0.003
Onroad Mobile	2201310412	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Urban Restricted Access / Evaporative Fuel Vapor Venting	0.000			0.000	0.000	0.001	0.000
Onroad Mobile	2201310413	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Urban Restricted Access / Evaporative Fuel Leaks	0.000			0.000	0.000	0.001	0.000
Onroad Mobile	2201310418	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Urban Restricted Access / Refueling Displacement Vapor Loss	0.000			0.000	0.000	0.001	0.000
Onroad Mobile	2201310419	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Urban Restricted Access / Refueling Spillage Loss	0.000			0.000	0.000	0.001	0.000
Onroad Mobile	2201310501	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Urban Unrestricted Access / Running Exhaust	0.005			0.139	0.002	0.023	0.009
Onroad Mobile	2201310509	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Urban Unrestricted Access / Brakewear	0.002			0.000	0.000	0.000	0.000
Onroad Mobile	2201310510	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Urban Unrestricted Access / Tirewear	0.001			0.000	0.000	0.000	0.000

Source Sector	SCC Code	SCC Description	$PM_{2.5}$ Total	PM_{25} Cond.	PM_{25} Filt.	NOx	SO_2	VOC	NH_3
Onroad Mobile	2201310512	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Urban Unrestricted Access / Evaporative Fuel Vapor Venting	0.000			0.000	0.000	0.003	0.000
Onroad Mobile	2201310513	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Urban Unrestricted Access / Evaporative Fuel Leaks	0.000			0.000	0.000	0.006	0.000
Onroad Mobile	2201310518	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Urban Unrestricted Access / Refueling Displacement Vapor Loss	0.000			0.000	0.000	0.004	0.000
Onroad Mobile	2201310519	Mobile Sources / Onroad Vehicles / Gasoline / Passenger Truck / Urban Unrestricted Access / Refueling Spillage Loss	0.000			0.000	0.000	0.004	0.000
Onroad Mobile	2201320102	Mobile Sources / Onroad Vehicles / Gasoline / Light Commercial Truck / Off-Network / Start Exhaust	0.010			0.034	0.000	0.110	0.000
Onroad Mobile	2201320113	Mobile Sources / Onroad Vehicles / Gasoline / Light Commercial Truck / Off-Network / Evaporative Fuel Leaks	0.000			0.000	0.000	0.005	0.000
Onroad Mobile	2201320116	Mobile Sources / Onroad Vehicles / Gasoline / Light Commercial Truck / Off-Network / Crankcase Start Exhaust	0.000			0.000	0.000	0.001	0.000
Onroad Mobile	2201320118	Mobile Sources / Onroad Vehicles / Gasoline / Light Commercial Truck / Off-Network / Refueling Displacement Vapor Loss	0.000			0.000	0.000	0.001	0.000
Onroad Mobile	2201320201	Mobile Sources / Onroad Vehicles / Gasoline / Light Commercial Truck / Rural Restricted Access / Running Exhaust	0.001			0.009	0.000	0.002	0.000
Onroad Mobile	2201320301	Mobile Sources / Onroad Vehicles / Gasoline / Light Commercial Truck / Rural Unrestricted Access / Running Exhaust	0.001			0.013	0.000	0.004	0.000
Onroad Mobile	2201320312	Mobile Sources / Onroad Vehicles / Gasoline / Light Commercial Truck / Rural Unrestricted Access / Evaporative Fuel Vapor Venting	0.000			0.000	0.000	0.001	0.000
Onroad Mobile	2201320318	Mobile Sources / Onroad Vehicles / Gasoline / Light Commercial Truck / Rural Unrestricted Access / Refueling Displacement Vapor Loss	0.000			0.000	0.000	0.000	0.000
Onroad Mobile	2201320401	Mobile Sources / Onroad Vehicles / Gasoline / Light Commercial Truck / Urban Restricted Access / Running Exhaust	0.001			0.007	0.000	0.002	0.000
Onroad Mobile	2201320501	Mobile Sources / Onroad Vehicles / Gasoline / Light Commercial Truck / Urban Unrestricted Access / Running Exhaust	0.001			0.020	0.000	0.008	0.000
Onroad Mobile	2201320512	Mobile Sources / Onroad Vehicles / Gasoline / Light Commercial Truck / Urban Unrestricted Access / Evaporative Fuel Vapor Venting	0.000			0.000	0.000	0.001	0.000
Onroad Mobile	2201320513	Mobile Sources / Onroad Vehicles / Gasoline / Light Commercial Truck / Urban Unrestricted Access / Evaporative Fuel Leaks	0.000			0.000	0.000	0.001	0.000
Onroad Mobile	2201320518	Mobile Sources / Onroad Vehicles / Gasoline / Light Commercial Truck / Urban Unrestricted Access / Refueling Displacement Vapor Loss	0.000			0.000	0.000	0.001	0.000
Onroad Mobile	2201420102	Mobile Sources / Onroad Vehicles / Gasoline / Transit Bus / Off-Network / Start Exhaust	0.000			0.000	0.000	0.001	0.000
Onroad Mobile	2201430102	Mobile Sources / Onroad Vehicles / Gasoline / School Bus / Off-Network / Start Exhaust	0.000			0.000	0.000	0.002	0.000
Onroad Mobile	2201520102	Mobile Sources / Onroad Vehicles / Gasoline / Single Unit Short-haul Truck / Off-Network / Start Exhaust	0.001			0.002	0.000	0.004	0.000

Source Sector	SCC Code	SCC Description	$PM_{2.5}$ Total	PM_{25} Cond.	PM_{25} Filt.	NOx	SO_2	VOC	NH_3
Onroad Mobile	2201520201	Mobile Sources / Onroad Vehicles / Gasoline / Single Unit Short-haul Truck / Rural Restricted Access / Running Exhaust	0.000			0.001	0.000	0.000	0.000
Onroad Mobile	2201520301	Mobile Sources / Onroad Vehicles / Gasoline / Single Unit Short-haul Truck / Rural Unrestricted Access / Running Exhaust	0.000			0.001	0.000	0.000	0.000
Onroad Mobile	2201520401	Mobile Sources / Onroad Vehicles / Gasoline / Single Unit Short-haul Truck / Urban Restricted Access / Running Exhaust	0.000			0.001	0.000	0.000	0.000
Onroad Mobile	2201520501	Mobile Sources / Onroad Vehicles / Gasoline / Single Unit Short-haul Truck / Urban Unrestricted Access / Running Exhaust	0.000			0.002	0.000	0.000	0.000
Onroad Mobile	2201530102	Mobile Sources / Onroad Vehicles / Gasoline / Single Unit Long-haul Truck / Off-Network / Start Exhaust	0.000			0.000	0.000	0.000	0.000
Onroad Mobile	2202210102	Mobile Sources / Onroad Vehicles / Diesel / Passenger Car / Off-Network / Start Exhaust	0.000			0.000	0.000	0.002	0.000
Onroad Mobile	2202310102	Mobile Sources / Onroad Vehicles / Diesel / Passenger Truck / Off-Network / Start Exhaust	0.000			0.028	0.000	0.044	0.000
Onroad Mobile	2202310201	Mobile Sources / Onroad Vehicles / Diesel / Passenger Truck / Rural Restricted Access / Running Exhaust	0.001			0.017	0.000	0.002	0.000
Onroad Mobile	2202310301	Mobile Sources / Onroad Vehicles / Diesel / Passenger Truck / Rural Unrestricted Access / Running Exhaust	0.001			0.032	0.000	0.004	0.001
Onroad Mobile	2202310401	Mobile Sources / Onroad Vehicles / Diesel / Passenger Truck / Urban Restricted Access / Running Exhaust	0.001			0.013	0.000	0.002	0.000
Onroad Mobile	2202310501	Mobile Sources / Onroad Vehicles / Diesel / Passenger Truck / Urban Unrestricted Access / Running Exhaust	0.002			0.057	0.000	0.008	0.001
Onroad Mobile	2202310519	Mobile Sources / Onroad Vehicles / Diesel / Passenger Truck / Urban Unrestricted Access / Refueling Spillage Loss	0.000			0.000	0.000	0.001	0.000
Onroad Mobile	2202320102	Mobile Sources / Onroad Vehicles / Diesel / Light Commercial Truck / Off-Network / Start Exhaust	0.000			0.010	0.000	0.016	0.000
Onroad Mobile	2202320201	Mobile Sources / Onroad Vehicles / Diesel / Light Commercial Truck / Rural Restricted Access / Running Exhaust	0.000			0.005	0.000	0.001	0.000
Onroad Mobile	2202320301	Mobile Sources / Onroad Vehicles / Diesel / Light Commercial Truck / Rural Unrestricted Access / Running Exhaust	0.000			0.010	0.000	0.002	0.000
Onroad Mobile	2202320401	Mobile Sources / Onroad Vehicles / Diesel / Light Commercial Truck / Urban Restricted Access / Running Exhaust	0.000			0.004	0.000	0.001	0.000
Onroad Mobile	2202320501	Mobile Sources / Onroad Vehicles / Diesel / Light Commercial Truck / Urban Unrestricted Access / Running Exhaust	0.001			0.017	0.000	0.003	0.000
Onroad Mobile	2202410102	Mobile Sources / Onroad Vehicles / Diesel / Intercity Bus / Off-Network / Start Exhaust	0.000			0.000	0.000	0.001	0.000
Onroad Mobile	2202410201	Mobile Sources / Onroad Vehicles / Diesel / Intercity Bus / Rural Restricted Access / Running Exhaust	0.000			0.004	0.000	0.000	0.000
Onroad Mobile	2202410301	Mobile Sources / Onroad Vehicles / Diesel / Intercity Bus / Rural Unrestricted Access / Running Exhaust	0.000			0.007	0.000	0.000	0.000

Source Sector	SCC Code	SCC Description	$PM_{2.5}$ Total	PM_{25} Cond.	PM_{25} Filt.	NOx	SO_2	VOC	NH_3
Onroad Mobile	2202410401	Mobile Sources / Onroad Vehicles / Diesel / Intercity Bus / Urban Restricted Access / Running Exhaust	0.000			0.003	0.000	0.000	0.000
Onroad Mobile	2202410501	Mobile Sources / Onroad Vehicles / Diesel / Intercity Bus / Urban Unrestricted Access / Running Exhaust	0.001			0.012	0.000	0.001	0.000
Onroad Mobile	2202420102	Mobile Sources / Onroad Vehicles / Diesel / Transit Bus / Off-Network / Start Exhaust	0.000			0.000	0.000	0.004	0.000
Onroad Mobile	2202420201	Mobile Sources / Onroad Vehicles / Diesel / Transit Bus / Rural Restricted Access / Running Exhaust	0.000			0.008	0.000	0.001	0.000
Onroad Mobile	2202420301	Mobile Sources / Onroad Vehicles / Diesel / Transit Bus / Rural Unrestricted Access / Running Exhaust	0.000			0.011	0.000	0.001	0.000
Onroad Mobile	2202420401	Mobile Sources / Onroad Vehicles / Diesel / Transit Bus / Urban Restricted Access / Running Exhaust	0.000			0.007	0.000	0.000	0.000
Onroad Mobile	2202420501	Mobile Sources / Onroad Vehicles / Diesel / Transit Bus / Urban Unrestricted Access / Running Exhaust	0.000			0.018	0.000	0.001	0.000
Onroad Mobile	2202510201	Mobile Sources / Onroad Vehicles / Diesel / Refuse Truck / Rural Restricted Access / Running Exhaust	0.000			0.001	0.000	0.000	0.000
Onroad Mobile	2202510301	Mobile Sources / Onroad Vehicles / Diesel / Refuse Truck / Rural Unrestricted Access / Running Exhaust	0.000			0.002	0.000	0.000	0.000
Onroad Mobile	2202510401	Mobile Sources / Onroad Vehicles / Diesel / Refuse Truck / Urban Restricted Access / Running Exhaust	0.000			0.001	0.000	0.000	0.000
Onroad Mobile	2202510501	Mobile Sources / Onroad Vehicles / Diesel / Refuse Truck / Urban Unrestricted Access / Running Exhaust	0.000			0.004	0.000	0.000	0.000
Onroad Mobile	2202520102	Mobile Sources / Onroad Vehicles / Diesel / Single Unit Short-haul Truck / Off-Network / Start Exhaust	0.000			0.002	0.000	0.007	0.000
Onroad Mobile	2202520201	Mobile Sources / Onroad Vehicles / Diesel / Single Unit Short-haul Truck / Rural Restricted Access / Running Exhaust	0.000			0.010	0.000	0.001	0.000
Onroad Mobile	2202520301	Mobile Sources / Onroad Vehicles / Diesel / Single Unit Short-haul Truck / Rural Unrestricted Access / Running Exhaust	0.001			0.018	0.000	0.002	0.000
Onroad Mobile	2202520315	Mobile Sources / Onroad Vehicles / Diesel / Single Unit Short-haul Truck / Rural Unrestricted Access / Crankcase Running Exhaust	0.000			0.000	0.000	0.000	0.000
Onroad Mobile	2202520401	Mobile Sources / Onroad Vehicles / Diesel / Single Unit Short-haul Truck / Urban Restricted Access / Running Exhaust	0.000			0.008	0.000	0.001	0.000
Onroad Mobile	2202520501	Mobile Sources / Onroad Vehicles / Diesel / Single Unit Short-haul Truck / Urban Unrestricted Access / Running Exhaust	0.001			0.035	0.000	0.004	0.000
Onroad Mobile	2202520515	Mobile Sources / Onroad Vehicles / Diesel / Single Unit Short-haul Truck / Urban Unrestricted Access / Crankcase Running Exhaust	0.001			0.000	0.000	0.000	0.000
Onroad Mobile	2202530102	Mobile Sources / Onroad Vehicles / Diesel / Single Unit Long-haul Truck / Off-Network / Start Exhaust	0.000			0.000	0.000	0.000	0.000

Source Sector	SCC Code	SCC Description	$PM_{2.5}$ Total	PM_{25} Cond.	PM_{25} Filt.	NOx	SO_2	VOC	NH_3
Onroad Mobile	2202530201	Mobile Sources / Onroad Vehicles / Diesel / Single Unit Long-haul Truck / Rural Restricted Access / Running Exhaust	0.000			0.001	0.000	0.000	0.000
Onroad Mobile	2202530301	Mobile Sources / Onroad Vehicles / Diesel / Single Unit Long-haul Truck / Rural Unrestricted Access / Running Exhaust	0.000			0.003	0.000	0.000	0.000
Onroad Mobile	2202530401	Mobile Sources / Onroad Vehicles / Diesel / Single Unit Long-haul Truck / Urban Restricted Access / Running Exhaust	0.000			0.001	0.000	0.000	0.000
Onroad Mobile	2202530501	Mobile Sources / Onroad Vehicles / Diesel / Single Unit Long-haul Truck / Urban Unrestricted Access / Running Exhaust	0.000			0.005	0.000	0.001	0.000
Onroad Mobile	2202610102	Mobile Sources / Onroad Vehicles / Diesel / Combination Short-haul Truck / Off-Network / Start Exhaust	0.000			0.000	0.000	0.004	0.000
Onroad Mobile	2202610201	Mobile Sources / Onroad Vehicles / Diesel / Combination Short-haul Truck / Rural Restricted Access / Running Exhaust	0.000			0.011	0.000	0.000	0.000
Onroad Mobile	2202610301	Mobile Sources / Onroad Vehicles / Diesel / Combination Short-haul Truck / Rural Unrestricted Access / Running Exhaust	0.001			0.020	0.000	0.001	0.000
Onroad Mobile	2202610401	Mobile Sources / Onroad Vehicles / Diesel / Combination Short-haul Truck / Urban Restricted Access / Running Exhaust	0.000			0.009	0.000	0.000	0.000
Onroad Mobile	2202610501	Mobile Sources / Onroad Vehicles / Diesel / Combination Short-haul Truck / Urban Unrestricted Access / Running Exhaust	0.002			0.037	0.000	0.002	0.000
Onroad Mobile	2202610515	Mobile Sources / Onroad Vehicles / Diesel / Combination Short-haul Truck / Urban Unrestricted Access / Crankcase Running Exhaust	0.000			0.000	0.000	0.000	0.000
Onroad Mobile	2202620102	Mobile Sources / Onroad Vehicles / Diesel / Combination Long-haul Truck / Off-Network / Start Exhaust	0.000			0.000	0.000	0.003	0.000
Onroad Mobile	2202620190	Mobile Sources / Onroad Vehicles / Diesel / Combination Long-haul Truck / Off-Network / Extended Idle Exhaust	0.002			0.214	0.000	0.043	0.001
Onroad Mobile	2202620191	Mobile Sources / Onroad Vehicles / Diesel / Combination Long-haul Truck / Off-Network / Auxiliary Power Exhaust	0.000			0.001	0.000	0.000	0.000
Onroad Mobile	2202620201	Mobile Sources / Onroad Vehicles / Diesel / Combination Long-haul Truck / Rural Restricted Access / Running Exhaust	0.001			0.028	0.000	0.001	0.000
Onroad Mobile	2202620301	Mobile Sources / Onroad Vehicles / Diesel / Combination Long-haul Truck / Rural Unrestricted Access / Running Exhaust	0.002			0.051	0.000	0.002	0.000
Onroad Mobile	2202620315	Mobile Sources / Onroad Vehicles / Diesel / Combination Long-haul Truck / Rural Unrestricted Access / Crankcase Running Exhaust	0.000			0.000	0.000	0.000	0.000
Onroad Mobile	2202620319	Mobile Sources / Onroad Vehicles / Diesel / Combination Long-haul Truck / Rural Unrestricted Access / Refueling Spillage Loss	0.000			0.000	0.000	0.000	0.000
Onroad Mobile	2202620401	Mobile Sources / Onroad Vehicles / Diesel / Combination Long-haul Truck / Urban Restricted Access / Running Exhaust	0.001			0.022	0.000	0.001	0.000
Onroad Mobile	2202620501	Mobile Sources / Onroad Vehicles / Diesel / Combination Long-haul Truck / Urban Unrestricted Access / Running Exhaust	0.005			0.091	0.000	0.004	0.000

Source Sector	SCC Code	SCC Description	$PM_{2.5}$ Total	PM_{25} Cond.	PM_{25} Filt.	NOx	SO_2	VOC	NH_3
Onroad Mobile	2202620515	Mobile Sources / Onroad Vehicles / Diesel / Combination Long-haul Truck / Urban Unrestricted Access / Crankcase Running Exhaust	0.001			0.000	0.000	0.000	0.000
Onroad Mobile	2202620519	Mobile Sources / Onroad Vehicles / Diesel / Combination Long-haul Truck / Urban Unrestricted Access / Refueling Spillage Loss	0.000			0.000	0.000	0.001	0.000
Nonroad Mobile	All		**0.244**			**1.212**	**10.620**	**0.410**	**0.000**
Nonroad Mobile	2260001020	Mobile Sources / Off-highway Vehicle Gasoline, 2-Stroke / Recreational Equipment / Snowmobiles	0.006			0.218	0.007	0.102	0.000
Nonroad Mobile	2265006015	Mobile Sources / Off-highway Vehicle Gasoline, 4-Stroke / Commercial Equipment / Air Compressors	0.000			0.001	0.000	0.000	0.000
Nonroad Mobile	2267002000	Mobile Sources / LPG / Construction and Mining Equipment / All	0.000			0.006	0.000	0.000	0.000
Nonroad Mobile	2267003020	Mobile Sources / LPG / Industrial Equipment / Forklifts	0.000			0.001	0.000	0.000	0.000
Nonroad Mobile	2268006020	Mobile Sources / CNG / Commercial Equipment / Gas Compressors	0.000			0.000	0.000	0.000	0.000
Nonroad Mobile	2270002000	Mobile Sources / Off-highway Vehicle Diesel / Construction and Mining Equipment / Total	0.003			0.017	0.001	0.000	0.000
Nonroad Mobile	2270003020	Mobile Sources / Off-highway Vehicle Diesel / Industrial Equipment / Forklifts	0.000			0.000	0.000	0.000	0.000
Nonroad Mobile	2270003030	Mobile Sources / Off-highway Vehicle Diesel / Industrial Equipment / Sweepers/Scrubbers	0.000			0.000	0.000	0.000	0.000
Nonroad Mobile	2270003040	Mobile Sources / Off-highway Vehicle Diesel / Industrial Equipment / Other General Industrial Equipment	0.000			0.000	0.000	0.000	0.000
Nonroad Mobile	2270006015	Mobile Sources / Off-highway Vehicle Diesel / Commercial Equipment / Air Compressors	0.000			0.003	0.000	0.000	0.000
Nonroad Mobile	2275000000	Mobile Sources / Aircraft / All Aircraft Types and Operations / Total	0.231			0.847	10.611	0.301	0.000
Nonroad Mobile	2285002006	Mobile Sources / Railroad Equipment / Diesel / Line Haul Locomotives: Class I Operations	0.003			0.107	0.000	0.005	0.000
Nonroad Mobile	2285002010	Mobile Sources / Railroad Equipment / Diesel / Yard Locomotives	0.000			0.010	0.000	0.001	0.000
Nonroad Mobile	2285002015	Mobile Sources / Railroad Equipment / Diesel / Railway Maintenance	0.000			0.001	0.000	0.000	0.000
TOTALS - ALL SECTORS/SOURCES			**3.532**			**16.364**	**21.639**	**14.331**	**0.238**

B. Emissions Reduction Calculations

2019/2020 TAS GRANT MEASURE EMISSION REDUCTIONS

1. Overview

This appendix to the 2019/2020 Targeted Airshed Grant (TAG) Application described the data and methods used to estimate emission reductions associated with grant funding of: 1) additional solid fuel device change-outs under the Borough's Wood Stove Change Out (WSCO) Program; and 2) Dynamic Message Signs (DMS), an infrared camera and expanded staffing to increase compliance with the state's Solid Fuel Device Curtailment Program. The methods documented herein are consistent with those applied to estimate control measure reductions under the Serious Area $PM_{2.5}$ State Implementation Plan (SIP) submitted by the Alaska Department of Environmental Conservation (ADEC) to the U.S. Environmental Protection Agency (EPA) in December 2019[1] and that are described in the Fairbanks $PM_{2.5}$ Nonattainment Area Emissions Inventory ("Inventory") appendix to the TAG Application. Detailed methods and emission reduction calculations for grant-funded WSCO Program activity and enhanced Curtailment Program Compliance are discussed separately below.

2. WSCO Program Reductions

As described in greater detail in Section 3 of the Inventory appendix, the Borough has operated the WSCO Program since 2010 and is designed to provide financial incentives for the replacement of older, higher-polluting residential wood-burning devices with new cleaner devices, or removal/repair of the old devices. The program has evolved/expanded over time with adjustments to the incentive levels and expansion of allowed replacement that now include conversion of solid-fuel devices to oil or natural gas-based home heating systems. Under its current design, the WSCO provides financial incentives ranging from $750 (catalyst repair) to $14,000 (conversion to a natural gas or electric system). The incentive levels are generally related to the level of emission reductions associated with each unit change-out.

Projected WSCO Activity

Under the 2019/2020 TAG Application, $9.9 million is being requested to fund additional change-outs. WSCO Program data collected for reporting requirements associated with awarded 2016 and 2017 TAS grants were analyzed and used to develop projected change-outs funded under this application. The Borough calculated the average reimbursement per change-out (based on current incentive levels) to be $6,288. With $9.9 million in funding, this would yield an estimated 1,578 additional change-outs.

Projected change-outs from the 2019/2020 TAG funding were developed by change-out type and calendar year based on data from the WSCO Program collected under reporting requirements for the 2016 and 2017 TAS grants. Change-outs were apportioned by type using these data as follows:

- SFBA→SFBA (20.5%) – replacement of uncertified solid fuel burning appliance (SFBA) with cleaner certified SFBA with a maximum 2.0 g/hour certification level;
- Conversion (55.7%) – conversion of existing SFBA to an oil, gas or electric heating system or removal of the existing SFBA;
- Removal (9.3%) – removal of an existing SFBA (with assumed heating energy replacement equivalent to that of home heating oil);

[1] https://dec.alaska.gov/air/anpms/communities/fbks-pm2-5-serious-sip/

- Bounty – non-deeded removal of an existing SFBA (with assumed heating energy replacement equivalent to that of home heating oil);
- Repair (0.4%) – repair of the catalyst or other emission reducing components; and
- NOASH Reduction (4.3%) – replace/repair/upgrade of SFBA's in NOASH (No Other Adequate Source of Heat) households to reflect heating energy replacement equivalence of home heating oil.

The percentages in parentheses in the list reflect change-out fractions by type from the 2016 and 2017 TAS Grant reporting data. The Bounty and NOASH Reductions are new program elements that are summarized below:

- Bounty Program – This element allows for non-deeded removal of an existing SFBA with eligibility throughout the nonattainment area. Currently, deeded SFBA removals are only allowed within the Air Quality Control Zone (AQCZ) portions of the nonattainment area. Lower reimbursements for Bounty transactions (relative to deeded Removals) ensures deeded Removals are still incentivized.
- NOASH Reduction - The NOASH Reduction element targets reductions in solid-fuel emissions from households that have no other adequate heat source (NOASH), and are currently granted a waiver from the Curtailment Program, when approved as a NOASH household. The NOASH Reduction element is intended to incentivize shifts from solid fuel burning in these households to cleaner fuel, assumed to be heating oil. In the absence of existing data for this element, is has been conservatively estimated that NOASH Reduction change-outs will increase over time, starting from 4 in 2020 and increasing to 21 in 2025.

Table 1 presents the resulting projected change-outs by type and calendar year from the 2019/2020 TAG funding. As shown in Table 1, 2019/2020 TAG change-out activity was projected over a six-year period (2020 through 2025). This annual "throughput" reflects current Borough staffing levels to operate the WSCO Program in conjunction with funding in-hand from earlier-awarded TAS grants. Zero change-outs in the first year (2020) in Table 1 conservatively reflect after mid-year availability of funds from the 2019/2020 grant coupled with the fact that historical WSCO program activity often peaks in the summer, prior to the expected availability of funds in 2020.

Table 1
Projected Change-Outs Under 2019/2020 TAG Application

Calendar Year	Change-Outs by Type						Total, All Types
	SFBA→ SFBA	Conversion	Removal	Bounty	Repair	NOASH Reduction	
2020	0	0	0	0	0	0	**0**
2021	20	56	10	10	0	4	**100**
2022	45	120	20	21	1	9	**216**
2023	70	189	31	33	2	15	**340**
2024	88	241	40	42	2	19	**432**
2025	100	273	46	48	2	21	**490**
Total	**323**	**879**	**147**	**154**	**7**	**68**	**1,578**

Table 2 presents the projected reimbursement rate and projections for the 2019/2020 grant funding.

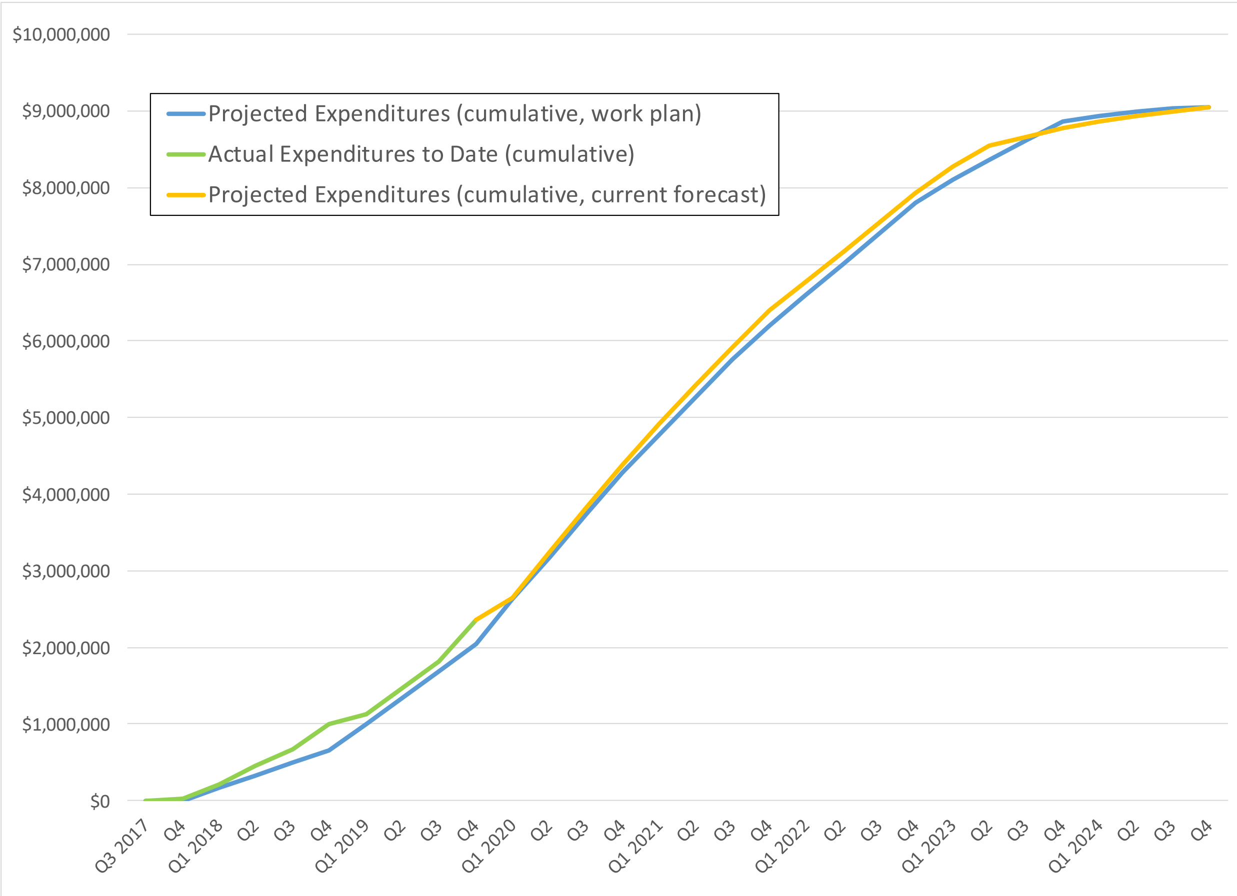
Table 2
2019/2020 TAG Reimbursement Rate and Projections

Program & Device Type	Replacement Option	Maximum Reimbursement	Average Reimbursement	Number of Devices	Total Reimbursement (average reimbursement x # of Devices)
Removal					
Hydronic Heater	x	$ 5,000	$ 5,000	52	$ 260,000
Wood- or Coal-Stove	x	$ 2,000	$ 2,000	48	$ 96,000
Pellet Stove	x	$ 2,000	$ 2,000	21	$ 42,000
Fireplace	x	$ 2,000	$ 2,000	26	$ 52,000
Replacement					
Hydronic Heater	Wood or Pellet Stove, Pellet HH	$ 10,000	$ 9,128	12	$ 109,536
Hydronic Heater	Emergency Power System	$ 10,000	$ 10,000	5	$ 50,000
Hydronic Heater	Home Heating Oil, Hot Water District Heat	$ 12,000	$ 11,860	74	$ 877,662
Hydronic Heater	Electric, Nat. Gas, Propane	$ 14,000	$ 14,000	5	$ 70,000
Wood- or Coal-Stove	Wood Stove	$ 4,000	$ 3,969	165	$ 654,826
Wood- or Coal-Stove	Pellet Stove	$ 5,000	$ 4,825	108	$ 521,121
Wood- or Coal-Stove	Home Heating Oil, Emergency Backup System, Hot Water District Heat, Electric	$ 6,000	$ 5,657	174	$ 984,356
Wood- or Coal-Stove	Nat. Gas, Propane	$ 10,000	$ 8,928	204	$ 1,821,253
Fireplace	Pellet Insert	$ 5,000	$ 4,999	38	$ 189,962
Fireplace	Home Heating Oil, Emergency Backup System, Hot Water District Heat, Electric	$ 6,000	$ 4,771	44	$ 209,902
Fireplace	Nat. Gas, Propane	$ 10,000	$ 9,238	373	$ 3,445,958
Repair					
Wood Stove	Repair	$ 1,500	$ 615	7	$ 4,302
NOASH Reduction					
Fuel Oil Appliance Repair/Replace/Upgrade		$ 5,000	$ 5,000	34	$ 170,000
Natural Gas Appliance Repair/Replace/Upgrade		$ 9,000	$ 9,000	34	$ 306,000
Bounty					
Hydronic Heater	x	$ 500	$ 500	58	$ 29,000
Wood- or Coal-Stove	x	$ 300	$ 300	58	$ 17,400
Pellet Stove	x	$ 300	$ 300	19	$ 5,700
Fireplace	x	$ 300	$ 300	19	$ 5,700
Totals			**$ 6,288.13**	**1,578**	**$ 9,922,676**

As required under the reporting requirements for TAGs, FNSB has actively tracked WSCO program expenditures on a quarterly basis from currently in-hand funds from the 2016, 2017 and 2018 grants. (Expenditures from the 2018 TAG begin in calendar year 2020.)

Figure 1 presents a chart of cumulative expenditures tracked on a quarterly basis. Actual expenditures through calendar year 2019 are plotted along with projections from the original TAG work plans along with the current projected expenditures.

Figure 2
Actual and Projected Expenditures from Existing TAGs (2016, 2017, 2018)



As seen in Figure 1, FNSB's WSCO program expenditures from the existing TAGs are tracking closely with projections and are expected to continue to do so through the end of the 2024.

An important element considered by ADEC and FNSB in developing this 2019/2020 TAG application consisted of the 5% per year emission reduction requirements that the Fairbanks $PM_{2.5}$ nonattainment area will face with submittal of a Five Percent SIP to EPA by December 2020. To optimize compliance with those 5% per year emission reduction targets, projected change outs under the 2019/2020 TAG will be back-loaded to augment change outs from the existing 2016, 2017 and 2018 TAG grants and extend theoretical maximum WASO Program throughput through calendar year 2025.

This is illustrated in Figure 2, which shows both historical (through 2019) and forecasted WSCO program activity under both the existing (2016, 2017, 2018) TAGs and this 2019/2020 TAG application. It shows how the projected 2019/2020 TAG-funded WSCO activity is back-loaded over the 2020-2025 period to optimize compliance with 5% per year emission reductions that will be required over this period under the Fairbanks Five Percent SIP (irrespective of other control measures) and to deal with theoretical annual WSCO program capacity (estimated to be 400 change outs per year through 2020 and then increasing by roughly 4% per year).

Figure 2
Historical and Projected Change Outs from Existing (2016-2018) and New 2019/2020 TAGs

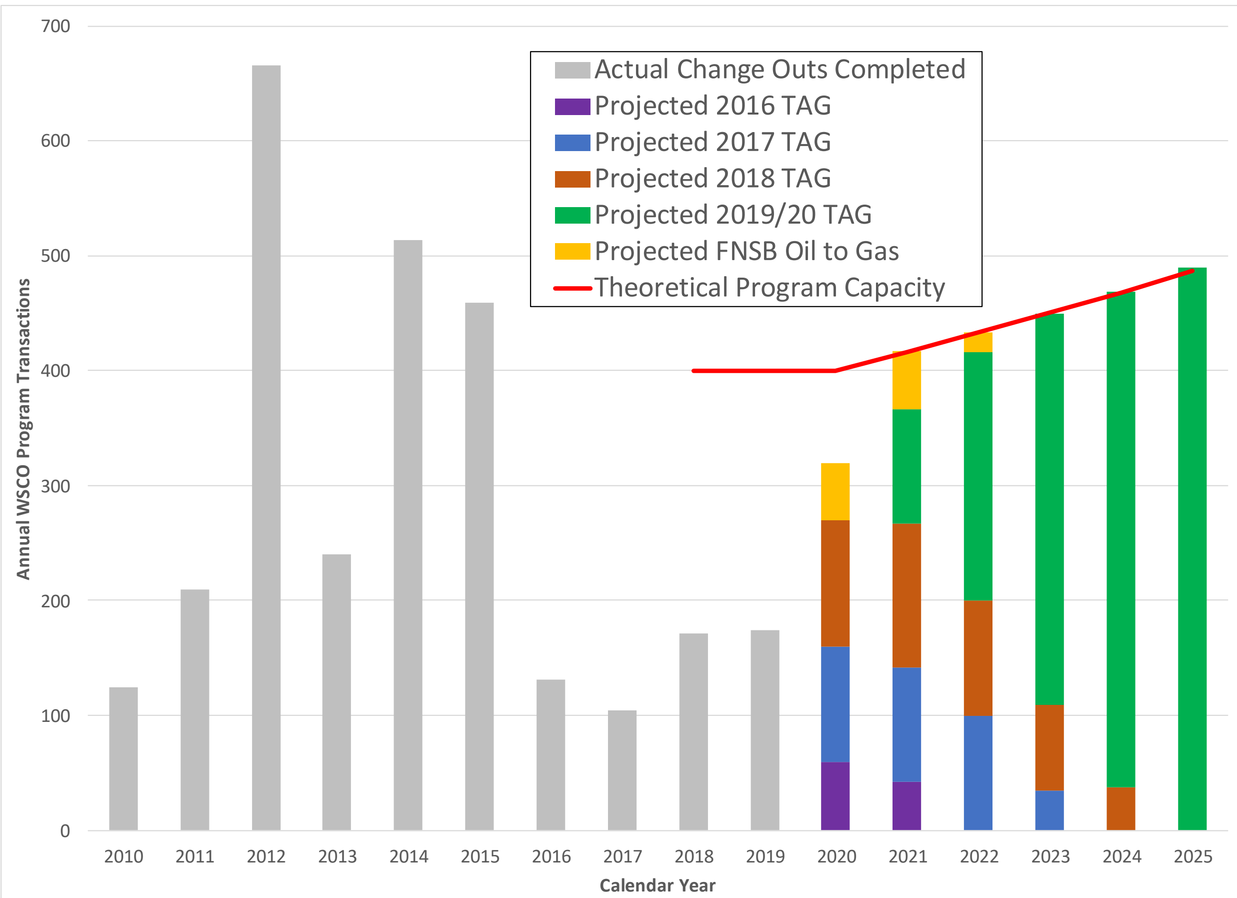


Figure 2 also includes forecasts for Oil to Gas (O-G) conversions being separately funded by FNSB outside the change out activity projected from TAG funding. Over 100 of these O-G conversions are projected from 2020 through 2022 as shown in Figure 2.

Although the historical data show that the WSCO program has exceeded 400 annual change outs in earlier years (2012 and 2014-2015), FNSB estimated the annual capacity of the program based on the following factors:

- *Professional Installation* – Beginning in 2017, the WSCO program was enhanced to require profession installation of replacement devices to ensure their proper and efficient operation.

- *Focused Geographic Area* – In earlier program years, eligibility extended over the entire nonattainment area. Under the current program, only households within the smaller Fairbanks and North Pole Air Quality Control Zones (AQCZs) are eligible.
- *Hot Spot Targeting* – FNSB further prioritizes WSCO applications within known $PM_{2.5}$ "hot spot" areas within the AQCZs identified under regulatory and special purpose ambient monitoring.
- *Improved Efficiencies* – The projected split of change outs from 2020 through 2025 and the related processing time between initial application and finalization are expected to result in a 4% increase in annual WSCO Program throughput from 2020 levels.

These factors collectively impact the theoretical maximum throughput of the WSCO program, relative to how the program was operated during earlier years. Thus, this analysis accounts for the difficulty in achieving higher annual change out levels recorded during these earlier years as well as expected efficiency improvements from 2020-2025.

Emission Reduction Calculations

Emissions reductions associated with these forecasted change-outs funded by the 2019/2020 TAG were calculated using emission factors and methods consistent with the Fairbanks Serious Area $PM_{2.5}$ SIP and explained in the "2019 Control Benefits Analysis" subsection within Section 3 of the Inventory appendix to this grant application. In essence, $PM_{2.5}$ and SO_2 emission benefits were calculated for each change-out by change-out or "transaction" type.

Historical WSCO Program data from the most recent two full years of the program (2017-2018) were used to develop average emission reductions per change-out type. (The most recent two years of data were selected since they reflect a period that generally matches the current WSCO Program design.)

The WSCO Program database compiled by the Borough contains the following elements for each WSCO change-out or transaction:

- Applicant information (including address);
- Program/transaction type (replacement, removal, repair);
- Old device type (e.g., fireplace, wood stove, OWB, etc.);
- Old device certification (uncertified or EPA-certified);
- Old device model (and certified emission rate for certified devices);
- New device type (which can include conversion to heating oil or natural gas devices);
- New device model;
- New device certification (where applicable);
- New device emission rate (where applicable); and
- Application status (pending or closed/completed).

For each completed transaction in the 2017-2018 WSCO Program database, $PM_{2.5}$ and SO_2 emission benefits were calculated using the information listed above. Emission factors (in lb/mmBTU) by device/technology/certification status used in the Serious SIP inventory were used to represent emissions for old devices being replaced, removed or repaired.

For wood-to-wood device replacements, emission factors of new devices were estimated from regression-based translations of certification emission rates (gram/hr) to emission factors (lb/mmBTU) developed from EPA certified wood burning device database. For solid fuel to oil/natural gas conversion replacements, inventory-based heating oil or natural gas emission factors were applied to represent "after change out" emissions from the new device.

For device repair transactions an average 10% emission reduction was assumed. (There were only a modest number of repair transactions, but some included repair of the catalyst and chimney which could provide measurable reductions or efficiency improvements).

In addition, for all device replacement transactions, effects of differences in old vs. new (or shifted) device heating efficiency were also accounted for. For example, assume an older uncertified wood stove with a heating efficiency of 50% was replaced with a cleaner, more efficiency wood stove with a heating efficiency of 75%. In addition to the emission reduction (based on the lb/mmBTU emission factors for each device, the difference in heating energy associated with the more efficient wood stove, in this case a reduction of 33.3% (50%/75%), was also accounted for in calculating "after replacement" emissions.

The emission reductions for each change-out transaction in the 2017-2018 WSCO Program database were then grouped by transaction type (SFBA→SFBA, Conversion, Repair) and average reductions per change-out were calculated. The results are shown below in Table 3.

Table 3
Average WSCO Program Emission Reductions by Change-Out Type

Change-Out Type	Average Emission Reductions per Change-Out (lb/day)	
	$PM_{2.5}$	SO_2
SFBA→SFBA	0.576	0.006
Conversion	1.178	-0.056
Removal	0.928	-0.023
Bountyl	0.928	-0.023
Repair	0.041	-0.188
NOASH Reduction[a]	0.928	-0.023

[a] In the absence of historical data, NOASH Reduction change-outs were assumed equivalent to Removals (with equivalent energy replacement from home heating oil).

As noted below Table 3, NOASH Reduction change-outs were assumed equivalent to those from conversions since they reflect replacement of a solid-fuel device with a heating oil/natural gas or electric heating system. As shown in Table 3, SO_2 emission reductions are slightly negative for conversion-related change-outs. This results from the fact that SO_2 emission factors per energy unit are higher for heating oil than solid fuel.

Table 4 presents estimated $PM_{2.5}$ and SO_2 emission reductions over the six-year period (2020-2025) for which TAS Grant funds are projected to be utilized within the Borough's on-going WSCO Program. These reductions were calculated by multiplying projected 2019/2020 TAG change outs by type from 2020-2025 shown earlier Table 1 by the unit reductions per change-out give in Table 3 (with conversion from pounds to tons).

Table 4
Total (2020-2025) WSCO Program Emission Reductions Under 2019/2020 TAG Application

Change-Out Type	Projected Change-Outs, 2020-2025	Total Emission Reductions, 2020-2025 (tons/day)	
		$PM_{2.5}$	SO_2
SFBA→SFBA	323	0.093	0.001
Conversion	879	0.518	-0.025
Removal	147	0.068	-0.002
Bounty	154	0.071	-0.002
Repair	7	0.000	-0.001
NOASH Reduction	68	0.032	-0.001
TOTALS	**1,578**	**0.782**	**-0.029**

3. Curtailment Program Reductions

As with the WSCO Program, emission benefits from enhancements to the Solid-Fuel Burning Appliance Curtailment Program were also developed using methodologies consistent with the Serious Area SIP. State regulations adopted with the Serious Area SIP have lowered the alert levels for the program to 20 $\mu g/m^3$ (Stage 1) and 30 $\mu g/m^3$ (Stage 2). (Prior alert levels were 25 and 35 $\mu g/m^3$.) Burn restrictions under Stage 1 allow only EPA-certified solid-fuel devices to operate. Under Stage 2, no solid-fuel devices are allowed to operate except those in NOASH households. The Curtailment Program and its alert stages apply to households within the Fairbanks and North Pole Air Quality Control Zones (AQCZs), which encompass 88% of the occupied households within the nonattainment area.

As summarized within the "2019 Control Benefits Analysis" sub-section in Section 3 of the Inventory appendix, emission reductions from the Solid-Fuel Burning Appliance Curtailment Program are governed by the overall compliance rate estimated for the program. Curtailment Program benefits were calculated in a manner similar to that applied under the Serious SIP. Reduction fractions were applied to Projected Baseline space heating emissions by device/technology type/fuel type using SCC[2]-level episodic space heating emissions data for the nonattainment area developed under the Serious SIP. These reduction fractions accounted for the fraction of devices (by SCC) operating under each curtailment stage, given the estimated compliance rate and the NOASH households fraction. The NOASH fraction within the nonattainment area was estimated at 4% based on survey data collected under the Serious SIP.

In addition to accounting for emission reductions associated with curtailment of solid fuel burning devices, the analysis also accounts for emissions from "shifted" energy use under each curtailment stage to heating oil and addresses efficiency differences between the solid fuel and heating oil devices.

Finally, the emission reductions are discounted to account for the fraction of households within the nonattainment area that are outside the Fairbanks and North Pole AQCZs within which the Curtailment Program applies. The fraction of nonattainment area emissions occurring within the nonattainment

[2] Source Classification Code

area, but outside these AQCZ was estimated at 12.4% and was determined from a GIS-based analysis of block-level occupied household data from the 2010 Census.

As described in the application, key funding elements expected to enhance the Curtailment Program by increasing its compliance rate include:

- Use of a Dynamic Messaging Sign (DMS) System to provide real-time information to motorist regarding curtailment alerts (for both program stages);
- Utilization of an infrared camera for compliance evaluation and enforcement; and
- Increased staffing for compliance monitoring.

Collectively, it was estimated that these mechanisms will increase the Curtailment Program's compliance rate by 5%. (Under the Serious SIP, the curtailment compliance rate is currently estimated to be 30%.) Table 5 summarizes the resulting incremental emission benefits associated with increasing the Curtailment Program from 30% to 35%, reflecting the operational enhancements listed above.

Table 5
Curtailment Program Emission Reductions (tons/day),
Current vs. Enhanced Compliance

	Reductions (tons/day)	
Program State	**$PM_{2.5}$**	**SO_2**
Current Curtailment Program, 30% Compliance	0.742	-0.120
Enhanced Curtailment Program, 35% Compliance	0.865	-0.140
Incremental Increase in Reductions:	**0.124**	**-0.020**

C. Biographical Sketch(s) - Attachment

2019 Targeted Air Shed Grant Program
RFA: EPA-OAR-OAQPS-20-01

Staff Experience and Qualifications

Primary Personnel Resume

1. Cynthia L. Heil
ADEC Air Quality Division
555 Cordova
Anchorage, AK 99501
(907) 269-7579
cindy.heil@alaska.gov

Education/Professional Certifications

- B.S. Natural Science, University of Alaska, Anchorage
- M.S. Environmental Quality, University of Alaska, Anchorage

Work History

- **Air Non-Point & Mobile Sources Program Manager, Division of Air Quality, Department of Environmental Conservation, Anchorage, AK, 2008-Present**

As the ANPMS Air Quality Program Manager I am tasked with the following responsibilities: develop, manage, supervise, and implement the Air Non-Point & Mobile Source Program, which is a statewide departmental program consisting of 2 managers and 6 lead professional staff, and 2 entry-level staff. ANPMS consists of 7 statewide major programs involving control of emissions from all motor vehicles; vehicle fuels; establishing air quality health standards for carbon monoxide, ozone, particulate matter; nitrogen oxides; sulfur oxides and volatile organic compounds; other air pollutants for which there are no health standards; adoption of air quality control plans to attain and maintain air quality standards or reduce emissions that might be injurious to public health or the environment; coordination of air quality issues and transportation; and regional haze. The position also manages the staff that develops and supports all regulation development for the division as well as all IT related efforts within the division.

This position requires the ability to explain complex and controversial issues through regular interaction with the general public, local elected officials, state agencies, and federal agencies. I am regularly required to prepare and present technical information in a public forum.

- **ANPMS Section Manager, Division of Air Quality, 1995-2008**

As the ANPMS Air Quality Program Manager I was tasked with the following responsibilities: develop, manage, supervise, and implement Air Non-Point & Mobile Source Program’s Mobile Source Section, which was a statewide departmental unit consisting of 1 manager and 3 lead professional staff, 2 mid-level staff, and 2 special project non-permanent staff. The section implements air quality control programs, air quality projects, and works with the Municipality of Anchorage and the Fairbanks North Star Borough to insure air quality requirements are met through the transportation planning process. This included, contract management, budget development, special project/grant writing, DEC's I/M Administrator and oversaw the I/M program statewide, represented the department on the Anchorage Metropolitan Area Transportation Solutions (AMATS) Technical Advisory Committee (TAC), credentialed as an Environmental Enforcement Officer, oversee the Division Data Systems, and a department representative on several national work groups.

- **Reclassified to Environmental Specialist III 11/1/1994 – 11/1/1995**
- **Environmental Specialist II 4/17-1992 – 11/1/1994**

I directed and supervised the day-to-day implementation of the Mobile Sources and Transportation Control Program. This included day-to-day interaction with the Anchorage Vehicle Inspection Program, intense public interaction, multiagency/industry/public coordination and immediate problem resolution of the mobile source program. I prepared position papers on the applicability of state and local laws pertaining to the regional transportation control program and acted as the state's liaison between state and local offices, industry, citizens and other concerned parties.

I directed and supervised the implementation of the Valley Commuter Vehicle Inspection Program and the Oxygenated Fuels Program for Anchorage. I drafted regional policies, guidelines, directives and correspondence concerning these programs. I tracked compliance and investigated complaints for possible enforcement actions. I initiated legal enforcement actions where necessary. I compiled materials for inclusion in legal and case files.

- **Intern (College III & Graduate) 3/21/1990 – 4/17/1992**

I conducted on-site inspections of industrial sources.

I conducted single agency reviews and participated in the review of long-range environmental plans with development of industrial sources within coastal zone management areas.

I assisted in the development and implementation of transportation control measures being employed to improve air quality in areas where ambient air quality standards are being violated.

I worked with other environmental programs, DEC divisions, and federal agencies to develop comprehensive air quality inspection procedures and forms to enhance information storage and retrieval.

I assisted with planning and budgeting.

- **Environmental Technician (nonperm) May 1989-August 1989**

I was a shoreline treatment monitor, monitoring shoreline clean-up operations for the Exxon Valdez Oil Spill. Duties included: operating small skiffs in and around clean-up sites, going on beach sites to observe treatment operations, ensured compliance with approved clean-up plans, evaluated the treatment methods being used and recommend possible improvements, acted as on-scene liaison with various scientific and resource management personnel, and resolved conflicts as they arose. In addition, duties included considerable written and visual documentation of treatment operations, plus assisting in taking water samples for the water quality division when needed.

Select Project Experience

I have developed or oversaw the implementation of several projects. At one point, managed 4 contracts of over $500,000 each that the same time.

- **Updated Inspection & Maintenance Program (I/M)**
  Due to Y2K (Year 2000) technical issues, all the I/M equipment (BAR84) and to be updated and replaced. Assisted in developing a new testing protocol incorporating the On-Board Diagnostic (OBD) testing requirements, the development of a Vehicle Information Database (VID), and using Congestion Mitigation and Air Quality (FHWA CMAQ) funds in one of the first public/private partnerships to assist in subsidizing the equipment in private garages. During this time also instituted a vehicle windshield sticker program to identify those with current I/M tests. Program update was successfully installed and in place within timeframe and budget.

- **Oxygenated Fuel Programs**
  After the difficult implementation and removal of the MTBE oxygenated fuel program, successfully implemented the Ethanol Blended Fuel's program in Anchorage. This included, regulation development, working with refiners, distributors, and retailers, developing and implementing a training program, managing inspections and oversight, answering questions from the public and elected officials, and keeping track of budgets.

- **Engine Block Heater Program**
  Designed and implemented an engine block heater program in Anchorage using CMAQ funding. Contracted with private garages, developed outreach material, presented on-going reports to the AMATS Policy Committee, develop a final report on effectiveness of the program to assist in carbon monoxide emissions from cold starts.

- **Diesel Emission Reduction Act (DERA) and American Recovery and Investment Act (ARRA) Projects**
  Over the course of several years, developed, implemented, or oversaw the reporting and finalization of projects following the DERA and ARRA-DERA granting requirements. These included:
    - Retrofitted and replace vehicle operated and maintained by Alaska Department of Transportation and the Alaska Railroad.
    - Oversaw the funding pass through to the Alaska Energy Authority to test and implement green engine for power generate in rural Alaska.

2. Adeyemi S. Alimi
ADEC Air Quality Division
555 Cordova
Anchorage, AK 99501
(907) 269-6953
adeyemi.alimi@alaska.gov

Education/Professional Certifications

- B.S. Chemical Sciences (Chemistry/Biochemistry), University of Agriculture Abeokuta, Nigeria
- M.S. Industrial Chemistry, University of Ibadan, Nigeria
- M.S. Medicinal/Organic Chemistry, Georgia State University, Atlanta Georgia

Work History

- **Air Non-Point & Mobile Sources Environmental Program Specialist, Division of Air Quality, Department of Environmental Conservation, Anchorage, AK, 2018-Present**

As the ANPMS Air Quality Environmental Program Specialist III, I represent the Department on the AMATS Technical Advisory Committee, and act as the contact person for general and transportation conformity, carbon monoxide, particulate matter, ultra-low-sulfur diesel, and vehicle emissions. I am the ADEC staff responsible for managing the EPA Target Airshed Grants and reporting requirements. As the Air Quality Division's webmaster, I assist in developing and managing the ANPMS web pages. In my position as EPS III, I assist in the development of state implementation plans to attain and maintain air quality standards for public health benefits.

- **Graduate Teaching Assistant, Department of Chemistry, Georgia State University 2015-2016**

As a graduate teaching assistant at Department of Chemistry, Georgia State University, I performed the following duties: Synthesized various anticancer organic compounds that could inhibit HIF pathway; taught organic chemistry 1 and 2 (Chem. 3000 & 3100); graded quizzes and laboratory reports accurately and fairly according to the guidelines of the supervisory faculty member, and maintained course attendance and grade records according to the department guideline.

- **Chemist/Laboratory Analyst: White Laboratories & White Environmental Consultants, Anchorage, AK 99501 2013-2014**

As a chemist/laboratory analyst with White Laboratories & White Environmental Consultants, I performed the following duties: Received samples from the log-in technician for analysis according to chain of custody and/or client request; prepared samples for analysis as assigned per accepted methods and standard operating procedures (SOPs); performed laboratory analysis as assigned to include atomic absorption analysis of lead in paint, air, wipes, soil, and TCLP, asbestos in air by phase contrast microscopy, and GC-MS analysis of OVM badges, filters, tubes and SKC monitors; worked with the analytical team to develop and improve analytical methodology and procedures; prepared written documentation and reporting of laboratory findings, and worked with analytical team to ensure data integrity

- **Quality Control Officer, Ibadan Nigeria 2004-2006**

As an independent quality control Officer, I performed the following functions: Oversaw the quality of Sachet water produced by carrying out physicochemical analysis on the finished products with a view to making sure they conform to the regulations as set by World Health Organization (WHO) and NAFDAC (National Agency for Food and Drug Administration and Control); carried out plant inspection and sanitation; ensured compliance to standard and good manufacturing practices, and assisted in procuring and reviewing NAFDAC number of finished products.

Select Project Experience

I wrote an annual baseline monitoring report of the FY-16 TAS grant per EPA request. I assisted in developing the 2018 TAS application. I have been responsible for reviewing the FY-16 and FY-17 quarterly reports (submitted to DEC by DCCED), and the submission to EPA.

3. Jason R. Olds

ADEC Air Quality Division
410 Willoughby Ave., Suite 303
Juneau, AK 99801
(907) 465-5303
Jason.olds@alaska.gov

Education/Professional Certifications

B.S. Fisheries and Wildlife, Michigan State University

Work History

- **Air Compliance Program Manager, Division of Air Quality, Department of Environmental Conservation, Juneau, AK, 2018-Present**

As the Air Compliance Program Manager I am tasked with the following responsibilities: serve as program lead for compliance and enforcement issues, planning biannual compliance monitoring strategies, planning annual compliance work for the program, ensuring consistent and effective compliance actions, periodically reviewing and assessing progress towards goals, coordinating compliance and enforcement with the EPA, tracking the resolution of violations and ensuring high priority violations are addressed timely and appropriate, ensuring adequate training of staff, identifying high profile compliance issues and preparing recommendations for approach to these issues, and representing the program in public and private forums dealing with compliance of on-going industrial operations in Alaska. The Compliance Program is a statewide departmental program consisting of 3 managers and 12 lead professional staff, and 5 entry-level staff. The Compliance Program is responsible for the inspection and administration of enforceable conditions in over 500 stationary source air quality permits, complaint response for air quality concerns from non-permitted facilities in Alaska, and seasonal waiver and curtailment enforcement in non-attainment areas.

This position requires the ability to analyze large data reports, understand and explain complex issues and negotiate sensitive settlements with the regulated community. I am frequently required to negotiate with permittees over contentious settlement agreements.

- **Air Compliance Program, Juneau Office Supervisor, Division of Air Quality, 2016 - 2018**

As the Air Compliance Program, Juneau Office Supervisor I was tasked with the following responsibilities: manage and supervise 4 program staff within the Juneau office, participate in the development of new or revised compliance and enforcement policies and procedures, assist in the development of standard inspection plans, suggest programmatic improvements to the Program Manager, serve as lead on project teams assigned, ensure compliance with permitted facilities assigned to the Juneau office through direct compliance work or delegation to office staff, serve as the office enforcement officer for case management and negotiated settlement.

- **Environmental Program Specialist III 2014 - 2016**

I oversaw the compliance and inspection of air quality emissions regulations on commercial passenger vessels (cruise ships) in Alaskan waters. As an inspector and enforcement officer, I was responsible for the negotiation and settlement of ongoing and backlogged enforcement cases with cruise ships. I implemented and managed a contract for hiring and observing vessels in ports around Alaska. I conducted compliance observations and audits on contractor readings first hand and communicated compliance concerns with responsible staff onboard each vessel.

Additionally, I assisted with permitting vessel discharge permits under an NPDES general permit, modeling cruise ship wastewater effluent, observed sampling by 3rd party contractors for adherence to QA/QC plans, and helped produce annual data reports on compliance performance metrics.

- **Environmental Program Specialist I/II 2012 - 2014**

I conducted on-site inspections of Title V major industrial sources throughout Southeast Alaska and on the North Slope.
I reviewed compliance reports and drafted enforcement recommendations to the office supervisor.
I assisted with the development of a general permit for minor sources in the aggregate industry across Alaska.
I worked on Title V Operating Permit renewals.

- **Environmental Program Technician (non-perm) 2011 - 2012**

I conducted on-site inspections of state air quality permitted facilities throughout Southeast Alaska.
I reviewed compliance reports under the supervision of the office supervisor.

I worked to disseminate and receive work products on Title V Operating Permit renewal projects to selected contractors working under the term contract.

Select Project Experience

I have developed, negotiated, and managed multiple enforcement cases at any one time. Since appointment of enforcement credentials, I have aided in the collection of over $3 million dollars in penalties and fines. In some cases, these settlements were of high public interest garnering national news and requiring careful communication of a politically sensitive industry in Alaska.

Since October, 2018 – the Air Compliance Program has been the lead/sole agency responsible for curtailment enforcement of regulations on SFBA’s in the Fairbanks PM2.5 Nonattainment area. In the 21 days between program adoption and learning of the municipal election’s outcome to overturn local curtailment enforcement – I helped develop and implement a program on limited resources.

4. ***Joey K. Ausel*** is the Alaska Department of Environmental Conservation (ADEC) Air Quality Administrative Operations Manager and Radon Program Manager and has worked for DEC since 2008. In her current role, she is responsible for oversight and management of the Division of Air Quality’s $10 Million budget and ensuring Division compliance with federal, state, and local administrative and financial requirements for a wide variety of funding sources. Prior to her current role in the Department, Joey worked as the Department’s Budget Manager responsible for the strategic planning the Department’s $80 Million operating budget and $100 Million capital budget. Additionally, she served as the Senior Grants Administrative for the Denali Commission managing the financial assistance agreements for $130 Million a year federal budget. Joey holds a Bachelors in Accounting and a Master’s in Business Administration and has completed courses in the Uniform Administrative Guidance.

5. ***Daniel Adamczak, PE,*** is the Alaska Department of Transportation (DOT) Northern Region Maintenance Engineer, and has worked for DOT since the summer of 2006. In his current role, he is responsible for design and oversight of a few dozen projects every year with varying scopes and budgets as well as serving as a liaison to other public, private, and government groups with interest in transportation related projects. Prior to his current role in the department, Daniel worked for the Department in both design and construction. During his time in design, he prepared and sealed plans specifications and estimates for projects of various sizes including a number of urban projects with a heavy focus on signing.

NICHOLAS CZARNECKI, P.E.

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(907) 459-1001
nczarnecki@fnsb.us

Education and Professional Certifications:
B.S. Mechanical Engineering, University of Wyoming, 2000
Professional Engineer (Mechanical), State of Wyoming, License No. 12729

WORK HISTORY

Air Quality Manager, Fairbanks North Star Borough, Fairbanks, AK, 2017-Present

The Fairbanks North Star Borough (FNSB) has the highest recorded 24-hour levels of fine particulate matter ($PM_{2.5}$) in the nation. As the local agency the FNSB Air Quality Division's responsibilities include special purpose monitoring, education and outreach, a wood stove change out program, and previously included an area source control program. As the FNSB Air Quality Division Manager I am tasked with the following responsibilities: manage day-to-day operations to ensure Division responsibilities are met, supervise 3 FNSB Air Quality Division employees, develop and execute the annual operating budget for the division, prepare and submit quarterly and annual budget and grant reports.

This position requires the ability to explain complex and controversial issues through regular interaction with the general public, local elected officials, state agencies, and federal agencies. I am regularly required to prepare and present technical information in a public forum. My position also requires participation in development of the State Implementation Plan (SIP), an effort that is led by the Alaska Department of Conservation (ADEC).

Air Quality Engineer, Lowham Walsh LLC, Lander, WY, 2011-2017

Lowham Walsh LLC (LW) was a full-service engineering and environmental consulting company serving private and public sector clients in Wyoming and the Intermountain West. LW was majority owned by Ecology and Environment, Inc. (E&E) an international environmental consulting firm working to develop technically sound, science-based solutions to the leading environmental challenges of our time (http://www.ene.com/).
In this position, I managed the air quality program for LW providing the following air quality services:

- Major and minor source permitting;
- Regulatory applicability analysis;
- National Environmental Policy Act (NEPA) analysis;
- Emission inventory calculations;
- Ambient monitoring; and,
- Compliance assistance.

As manager of the air quality program, I was responsible for business development which included: developing marketing leads, maintaining relationships with existing clients, and public presentations at professional conferences. Once an opportunity was identified I lead the proposal writing and project costing efforts. After a project was secured I worked through contracting issues, provide project management, supervised support staff, and completed technical air quality work. My position also involved significant coordination with the E&E air quality team to balance workloads on projects shared between the two companies.

In 2013 I was selected to serve as a member of the Board of Managers for LW. The Board of Managers meet quarterly to assess the performance of the company and my responsibilities included: staffing decisions, compiling projections, business development, strategic planning, and budget reviews for the firm. Additionally, I served as the lead engineer for LW responsible for all engineering conducted at the firm.

Air Quality Engineer, Wyoming Department of Environmental Quality (WDEQ), Division of Air Quality, Lander, WY, 2002 – 2011

In this role, I was responsible for performing technical tasks related to the air quality compliance program within the southwest district of Wyoming, by applying engineering principles and concepts to inspect and evaluate a wide variety of industrial processes and emission control equipment to ensure air quality requirements were met. Duties included:

- Conferring with facility engineers and senior level environmental personnel regarding the design, construction, and operation of facilities to enforce compliance with state and federal requirements.
- Evaluating the results of performance tests and other technical data.
- Calculating facility emissions based on operational data, technical performance data and/or accepted engineering practices.
- Writing detailed compliance reports based on research, inspection, analysis and evaluation of data pertaining to facility operations.
- Providing technical assistance for the South Pass ambient monitoring site, which measures NO_2, Ozone, $PM_{2.5}$, and collects meteorological data.

Mechanical Engineer, Detection Limit, Laramie, WY, 2000 – 2002

Designed optical-mechanical components for spectrometry instrumentation using AutoCAD 3-D modeling, and produced 2-D working drawings for production of parts.

CAD Draftsman, Western Research Institute, Laramie, WY, 1999-2000

Completed a drawing package for prototype soil testing instrument, under supervision of senior engineer, to manufacture a pre-production run of 25 units.

SELECT PROJECT EXPERIENCE

PM_{10} Ambient Monitoring (LW)

I completed an analysis to determine if site specific pre-construction ambient air monitoring would be beneficial to future permitting actions for CML Metals, an iron mine in southern Utah. The results showed that establishing new background PM_{10} concentrations could prove beneficial during future modeling analysis, because existing data was not representative of current conditions. Site selection was evaluated and a Quality Assurance Project Plan was developed prior to monitor installation. Equipment was procured and installed under my direction. The site consisted of a Federal Equivalent Method Met One BAM 1020 continuous PM_{10} monitor and a Federal Reference Method Thermo Scientific Partisol filter based PM_{10} monitor. Wind speed, wind direction, temperature, and relative humidity for baseline meteorological data were also collected. I managed two technical level employees, budget, and quality control for the project. The monitor successfully gathered 12 months of PM_{10} ambient data.

Air quality permitting for Liquefied Natural Gas export terminal (E&E)

For a confidential client, I worked with a team of air quality experts to prepare permit applications for a Liquefied Natural Gas (LNG) terminal and associated pipeline compressor stations located in Texas. Due to the size of the facility and magnitude of emissions, the LNG terminal was classified as a Prevention of Significant Deterioration (PSD) source requiring extensive analysis during the permitting process. The Front End Engineering Design (FEED) was developed concurrent with the PSD permit application requiring collaboration between the engineering firm, the client, and our air quality team. I lead development of the Best Available Control Technology (BACT) analysis for 10 emission source categories for the following pollutants: NO_X, CO, PM_{10}, $PM_{2.5}$, VOC, and GHG. I was responsible for regulatory analysis and technical review of emission estimates developed by the engineering firm. I represented the client in multiple regulatory meetings with the Texas Commission on Environmental Quality (TCEQ). I also supervised the air quality engineer conducting the modeling analysis which included NO_2, CO, PM_{10}, and $PM_{2.5}$. The analysis included modeling the LNG terminal as a stand-alone source for comparison to the National Ambient Air Quality Standards (NAAQS) and cumulative modeling for PSD increment analysis. The permit application deadline was met and the application is currently under regulatory review.

Environmental Impact Reports for California Public Utilities Commission (E&E)

I have been involved in two California Public Utilities Commission (CPUC) projects. The SOCRE project included upgrades to existing electrical infrastructure and consisted of replacing electrical substations and transmission lines. The Mesa project consisted of upgrading an existing electrical substation and associated transmission lines. Both projects were located in southern California. I authored the air quality and climate change sections for both Environmental Impact Reports (EIRs) which were prepared to comply with the California Environmental Quality Act (CEQA). Existing air quality conditions were researched and described. The regulatory setting associated with each project was described. Construction and operation emissions were evaluated and compared with regional and local thresholds to determine significance of air quality impacts. Mitigation measures were developed for any significant impacts including NO_X, PM_{10}, and $PM_{2.5}$.

Environmental Assessment for Solar Photovoltaic Systems at Naval Bases in California (E&E)

I completed the air quality analysis for construction emissions at five solar photovoltaic systems at multiple naval bases in California. The work included estimating vehicle, fugitive dust, and greenhouse gas emissions. The air quality analysis included characterization of four air basins along with General Conformity Analysis due to non-attainment areas. I authored the air quality section in the Environmental Assessment (EA) for affected environment and environmental consequences.

Roan Plateau Supplemental Environmental Impact Statement (E&E)

The Roan Plateau oil and gas development consists of new federal oil and gas leases located on land managed by the BLM in Colorado. Prior to approval of the federal oil and gas leases a SEIS was required, and I was on a team that authored the air quality and climate change sections of the SEIS. The air quality analysis relied on results of the Colorado Air Resources Management Modeling Study (CARMMS). CARMMS was developed by the BLM to provide an analysis of regional and cumulative air quality and air quality related value (AQRV) impacts from future federal and non-federal energy development in Colorado. The CARMMS models future air quality projected for the year 2021 for a four-kilometer domain covering all of Colorado. Cumulative air quality impacts, including criteria pollutants, AQRVs and climate change, were assessed for three development scenarios. Mitigation measures were developed based on BLM's Comprehensive Air Resource Protection Protocol (CARPP).

Air Quality Permitting for CO_2 Oil Recovery Facility (LW)

I successfully obtained an air quality construction permit for Devon Energy Production Company's Big Sand Draw CO_2 Enhanced Oil Recovery Facility which is located in Wyoming. During the application process, I worked closely with Devon's environmental staff and process engineers to ensure that the new facility was below PSD and Title V thresholds. Process modifications were made during the permitting process to keep the facility under greenhouse gas (GHG) thresholds for PSD and under NO_X/VOC thresholds for Title V. The permit application included modeling analysis for NO_2 and formaldehyde along with BACT analysis for the natural gas fired engines. The project was fast tracked to meet construction schedules through close coordination with Wyoming DEQ permitting engineers.

Oil and Gas Production Site Inspections (WDEQ)

At the DEQ I was tasked with streamlining the oil and gas production site inspection process for southwest Wyoming. I designed an updateable GIS database containing over 13,000 permitted oil and gas production sites in southwest Wyoming for compliance and inspection tracking. The GIS database linked with an existing permits database (MS Access) and Wyoming Oil and Gas Conservation Commission data (MS Excel). With the datasets linked inspectors could filter large amounts of data, and more efficiently identify potential compliance issues. Data sets were available remotely in the field, allowing field personnel to increase inspection frequency from 5 sites per day up to 20 sites per day.

At the time, infrared cameras were an emerging technology for detection of hydrocarbon emissions. I was on a team that developed the WDEQ protocol for use of infrared cameras to detect and document fugitive hydrocarbon emissions at oil and gas production facilities. I successfully procured a $120k infrared camera along with the necessary calibration equipment for the program.

TRAINING AND CERTIFICATIONS

- AERMOD Air Dispersion Modeling – *Lakes Environmental*, May 2015
- Applying the NEPA Process and Writing Effective NEPA Documents - *The Shipley Group*, July 2013
- NSR/PSD Compliance Workshop - *Trinity Consultants*, July 2013
- Production Technology – Surface - *University of Texas, Petroleum Extension*, March 2010
- ArcGIS Desktop II: Tools and Functionality - *University of Wyoming, WYGISC*, November 2008
- GasFindIR Thermographer Certification - *Infrared Training Center*, October 2008
- Engines, Turbines, and Asphalt Plants - *California Air Resource Board*, September 2005
- Level I – Air Compliance Training - *Rutgers University, Air Compliance Center*, February 2005
- Source Sampling Workshop - *Walter Smith and Associates, Inc*., February 2003
- Inspection of Gas Control Devices - *Air Pollution Training Institute*, August 2003
- Inspection of Particle Control Devices - *Air Pollution Training Institute*, August 2003
- EPA Method 9 Certified – 2002 - 2011

REFERENCES

Ann Shed
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Cell: (307) 850-8972

Greg Johnston
Environmental Specialist
Chesapeake Energy Corporation
e-mail: lincolnjohnston@yahoo.com

Office: (405) 935-1124
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Additional references available upon request.

D. Negotiated Indirect Cost Rate Agreement

Department of Transportation & Public Facilities

Administrative Services Division

Phone: 907-465-8829

Fax: 907-465-3124

MEMORANDUM

TO: Distribution

DATE: January 13, 2020

FROM: Dom Pannone
Director DMP

SUBJECT: FY2021 Indirect Cost Rate Proposal Rates

The Indirect Cost Rate Proposal (ICRP) for FY2021 has been submitted for approval to the Federal Highway Administration (FHWA).

When approved, the rates listed below will be used to assess ICAP charges against capital project expenditures that are processed on or after approval by FHWA.

Rate Type	FY21 Rate	FY20 Rate	Increase / (Decrease)
Federal Highways CIP	4.75%	7.64%	-2.89%
State Highways CIP	2.04%	5.20%	-3.15%
Federal Airport CIP	6.34%	9.61%	-3.27%
State Airport CIP	7.23%	12.52%	-5.29%
Public Facilities CIP	10.36%	9.56%	0.80%
Reimburs. / Harbors / Misc CIP	2.77%	10.00%	-7.23%

Factors resulting in these rate differences include the following:

- The FY2020 rates incorporated the significant under-recoveries of indirect expenses that occurred during FY2018 (approximately $19 million under-recovery across all cost groups). This element caused FY2020 rates to be substantially higher than normal for a single year. In contrast, the FY2021 rates incorporate a small over-recovery of $2.9 million across all cost groups, which acts to reduce rates slightly. The combination of not having a significant under-recovery, but instead having a slight over-recovery, acts to reduce the rates significantly.

- Direct spending levels in capital projects have exhibited significant annual swings. The department has refined its method of estimating future year direct costs, and has adopted a four year average method of estimating these costs, instead of the one year prior method previously used. It is anticipated that a four-year average method of estimating future fiscal year direct spending will smooth over/under recovery and rate fluctuations. This four-year average method is applied in all cases except for the Public Facilities Combined Cost Group (PFCCG). Prior to FY2020, the PFCCG did not include Facilities operating, as the Division of Facilities Services did not exist, so historical information is not available.

The FY2021 proposed rates could be subject to adjustment if there are any major changes in the FY2021 budget for salaries and benefits, or other unforeseen costs.

Unique ICRP's on general fund pass-through projects must be requested on an individual basis. Justification must demonstrate that there is no department oversight or ultimate financial responsibility, and DOT&PF's only involvement is to provide funding. Requests for unique rates must be submitted for each project impacted via memo through me to the Commissioner.

The rates currently in place will continue to be assessed against capital project expenditures processed until FHWA has approved new rates. If FHWA approval is not received by July 1, 2020 a one-time adjustment to retroactively charge FY2021 rates will be applied.

These rates are assessed on total project costs. At the end of each week, total project expenditures for that week are determined and multiplied by the appropriate rate. The resulting amount is charged to each project on the Friday following the direct expenditures.

Please contact Susan Endicott, 465-2079 susan.endicott@alaska.gov or Christina Zepp, 465-8118 christina.zepp@alaska.gov if you have any questions.

Distribution List:

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John Binder, Deputy Commissioner
Mary Siroky, Acting Deputy Commissioner
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Lance Mearig, Regional Director, Southcoast Region
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Jennifer Coisman, Central Region Project Control
Jerry Mastin, AMHS Vessel Contract Manager
Vicky Roberts, Administrative Operations Manager, Southcoast Support Services

E. Quality Assurance Narrative Statement – Attachment

Federal Fiscal Year 2020
(State Fiscal year 2020)
2019 Targeted Air Shed Grant Program
RFA: EPA-OAR-OAQPS-20-01

EPA regulations as stated in 40 CFR 30.54 require the inclusion of a Quality Assurance Narrative Statement (QANS) for any application involving data collection or processing, environmental measurements, and/or modeling. The QANS provides information on how quality processes or products will be assured. The individual elements of a QANS are listed and addressed as follows:

1. Identify the individual who will be responsible for the quality assurance (QA) and quality control (QC) aspects of the research along with a brief description of the person's functions, experience, and authority within the research organization.

   Nick Czarnecki, the Fairbanks North Star Borough (FNSB) Air Quality Manager will be responsible for QA and QC of data collected. A brief description of Mr. Czarnecki's function and experience can be found in attachment C of the grant application. The proposed solid fuel burning appliance (SFBA) conversion program does not have a research component. The proposed marketing and outreach activities do not have a research component.

2. Discuss project objectives, including quality objectives, any hypotheses to be tested, and the quantitative and/or qualitative procedures that will be used to evaluate the success of the project. Include any plans for peer or other reviews of the study design or analytical methods

   The proposed SFBA conversion program's objectives are to reduce PM2.5 emissions within the FNSB PM2.5 non-attainment area. Emission reductions are to be real and permanent. The quantitative procedure to determine actual emission reductions are described in section iii. Analysis of Emissions Inventory. Emission reductions are considered permanent through appliance destruction and deed restrictions, details can be found in section ii. Ongoing, Significant Reduction of Emissions. No peer review is planned.

   The proposed marketing and outreach objectives are to reduce PM2.5 emissions within the FNSB PM2.5 non-attainment area by increasing the compliance rate for various control measures through increased marketing, public relations, education, and outreach. There is no direct quantitative comparison at this point to claim PM2.5 reductions from marketing and outreach activities.

3. Address each of the following project elements as applicable:

a. Collection of new/primary data.
   New/primary data will not be collected.
b. Use of existing/secondary data.
   Existing/secondary data will not be used.
c. Method development.
   Not applicable.
d. Development of refinement of models.
   Not applicable.
e. Development or operation of environmental technology
   Not applicable.
f. Conducting surveys.
   Not applicable.

4. Discuss data management activities (e.g., record-keeping procedures, data-handling procedures, and the approach used for data storage and retrieval on electronic media). Include any required computer hardware and software and address any specific performance requirements for the hardware/software configuration used.

   Data management is described in section e. Environmental Results – Outcomes, Outputs, & Performance Measures.

F. Partnership Letters and letters of Support

THE STATE of ALASKA
GOVERNOR MIKE DUNLEAVY

Department of Transportation and Public Facilities

NORTHERN REGION
Director's Office

2301 PEGER ROAD
FAIRBANKS, ALASKA 99709-5316
Main: 907-451-2210
dot.alaska.gov

March 16, 2020

U.S. Environmental Protection Agency
Office of Air Quality Planning & Standards
2019 Targeted Airshed Grant Program

Subject: Letter of Support for the Targeted Airshed Grant Application

To Whom It May Concern:

The State of Alaska Department of Transportation and Public Facilities (ADOT&PF) fully supports the application for the 2019 Targeted Airshed Grant Program submitted by the Alaska Department of Environmental Conservation's (DEC) Air Quality Division.

This grant will fund the design, installation and operation of two large highway electronic signs to facilitate immediate communication of air quality alerts with the goal of increasing curtailment compliance.

The Fairbanks area has been designated a Serious Nonattainment area for fine particulate matter ($PM_{2.5}$) by the Environmental Protection Agency (EPA). Increasing compliance with stage restrictions is expected to show the biggest near term impact on reducing $PM_{2.5}$ emissions. The largest portion of $PM_{2.5}$ levels are from wood smoke and significant reductions in emissions are still needed to meet the standards.

If awarded, ADOT&PF is committed to partnering on this project by completing the site design, procuring the equipment, facilitating the construction of the sites, as well as the operations and maintenance. This includes working with DEC on the Alert procedures and message prioritization. The Department has completed initial site visits and identified the preferred locations for two priority sites on the Richardson Highway between Fairbanks and North Pole and on the Parks Highway near Geist Road.

Sincerely,

Ryan F. Anderson, P.E.
Director

"Keep Alaska Moving through service and infrastructure."

IGU INTERIOR GAS UTILITY

January 30, 2020

Subject: Interior Gas Utility (IGU) Support of the 2019 TAG Grant Application for Fairbanks

I am writing in support of Alaska Department of Environmental Conservation (DEC) and Fairbanks North Star Borough (FNSB), 2019 TAG Grant Application for Fairbanks SFBA Conversion & Removal Program. The IGU's mission is to provide low cost, clean burning, natural gas to the most people in the Fairbanks North Star Borough as possible, as soon as possible. As a public utility, the IGU is focused on lowering energy costs and improving the quality of life for all of those who live and visit here. We strive to bring both economic and environmental relief to the residents of the Interior to keep our community vibrant.

IGU works with the DEC and FNSB to assist in improving the air quality in the Non-Attainment areas by endeavoring to switch residents to natural gas as their primary fuel source. In our experience many residents of the FNSB would like to convert to natural gas, but simply can't afford the conversion costs. The grant provides financial incentives to increase conversions to natural gas by removing cost as a major obstacle of conversion.

IGU has completed the construction of a 5.25 million gallon capacity storage facility. We have completed the ground work for a North Pole storage facility. The North Pole Storage Facility will be completed in the Fall of 2020. The two facilities provide the necessary inventory and supply to support new customers that we can add in the FNSB. In 2020 we are looking to add 125-300 new customers, with 300-800 new customers added each year thereafter until natural gas is the primary energy choice of FNSB residents. Increased natural gas distribution throughout the community has long been viewed as a critical step towards the area meeting attainment. Without an incentive program, conversion to natural gas throughout the community will be more expensive and take more time. The grant would be a major step forward in meeting attainment by eliminating a significant barrier for many in regards to the cost of conversion.

IGU fully supports the DEC and FNSB in the 2019 TAG Grant Application.

Sincerely,

Daniel Britton
General Manager

3408 International Street
Fairbanks, AK 99701

907 452 7111
interiorgas.com

Fairbanks
Economic Development Corporation

330 Wendell Avenue, Suite E, Fairbanks, AK 99701

January 29, 2020

Dear XXX,

As President and CEO of the Fairbanks Economic Development Corporation, I would like to voice my support of the Fairbanks North Star Borough's and the Alaska Department of Environmental Conservation's application for the EPA Targeted Air Shed Grant.

For many years FEDC has held fast to the ideal that is it "OUR Community, OUR Economy and OUR responsibility" and has recognized the solution to our area's air quality issues needs to come from within the community. Partnering with other large players in the Borough, FEDC supported and coordinated the Air Quality Stakeholders Group to facilitate a community supported solution from a diverse network of stakeholders in 2018. Today we are continuing that work with the Air Quality Coalition that seeks community solutions to this ongoing issue.

With the stakeholder group's recommendations incorporated into our communities Serious SIP there is a wide range of regulations that include, among other things, removal of specific types of solid fuel burning devices. The adoption and use of cleaner-burning fuel sources such as natural gas or fuel oil as a primary space-heating fuel for our community is contingent upon the assistance these grants provide. Each and every recommendation and regulation serves a purpose in engaging our community in the effort to reach attainment but few offer the possibility of addressing (on a long-term, sustainable basis) the underlying challenge "cost of energy to consumer" has played in creating the community's air quality dilemma like natural gas and these change out options.

The Targeted Air Shed Grant provides specific and necessary funds to help bring our borough into clean air attainment. I hope you will support our community in its efforts to educate the public and assist in its transition to cleaner use of currently available (oil and wood) and soon to be much more widely available (natural gas) fuels, by approving the Fairbanks North Star Borough's and the Alaska Department of Environmental Conservation's application for the EPA Targeted Air Shed Grant.

Respectfully,

Jim Dodson
President & CEO
Fairbanks Economic Development Corporation